THE

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	Page
Durham Miners and Electricity	441
Short-Circuit Tests on a Single-Phase Railway	442
Electric Power in the Works of Messrs. Armstrong, Whitworth and Co., Ltd., Manchester (*illus.*) (*concluded*)	443
The Single-Phase Motor	446
How we got the Order	447
The Measurement of the Insulation of a Live Three-Wire System (*illus.*)	448
An Improved Form of Condenser for Power Work (*illus.*)	449
Electrical Devices for Handling Material at Gary (*illus.*)	449
Correspondence:—	
Storekeeping for an Electricity Works	450
The New Theory of Electricity	450
What is an Electrician?	451
Electric Miners' Lamps	451
Tramway Power Tariffs	452
Ignition Magnetos	453
Packing for Shipment (*illus.*)	453
Curious Lamp Failure	453
Carbon Brushes	454
Proceedings of Institutions:—	
Hydro-Electric Power in Canada	454
New Electrical Devices, Fittings and Plant (*illus.*)	456
Business Notes	457
Notes	465
City Notes	467
Market Quotations	468
Stocks and Shares	468
Share List of Electrical Companies	469
The Lighting of a Large Exhibition Hall (*illus.*)	471
Specifications for Truck Parts	471
Reviews	472
The Enclosed Arc, or the Metal-Filament Lamp?	474
British Trade with China	475
Notes on Trade Abroad (*continued*)	476
Foreign and Colonial Tariffs on Electrical Goods	479
New Patents Applied For, 1909	480
Published Specifications	480
Contractors' Column	Advertisement pages 56, 58 and 60

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DURHAM MINERS AND ELECTRICITY.

AT a Council meeting of the Durham Miners' Association, held at Durham City, on September 4th, a resolution was considered with regard to electricity in mines, and containing a request that electric machinery and cables be taken out of the pits, as they were considered a source of great danger. It was explained that a Select Committee had been appointed by the Government to go into the matter, and that the owners would not object to a meeting on the question, and in view of this explanation the resolution was withdrawn.

This is the outcome of the remarks upon the lamentable disaster at the West Stanley Colliery, contained in the last annual report of Mr. Wilson, M.P., Secretary of the Durham Miners' Association, to which full reference was made in the ELECTRICAL REVIEW for May 21st, 1909. Mr. Wilson therein stated that it was his own opinion that this explosion was caused by electricity, and in spite of the coroner's jury's verdict and the report of H.M. Inspectors of Mines, who both stated that the cause was not ascertained, there is a general opinion in the North of England that electricity was the secondary cause of the explosion, if not the primary. In view of such a general impression, it is useless to mince matters, and it will be better at once to admit the possibility and face the question boldly. One thing is certain, had it not been for the West Stanley explosion the above resolution of the Durham miners would never have been moved.

It may be of interest, therefore, to consider the question of electricity in mines from a miner's point of view. By miner, we mean the coal-hewer, who forms the majority of those employed in a coal mine as well as of the members of the Association; and he is absolutely ignorant of electricity or its working. His occupation is to get the coal down and fill it into tubs or wagons, which are then taken from the working place or "face" by the "putter"—who may be looked upon as the hewer's assistant—to a point, commonly termed a "flat," from whence they are removed by horse or mechanical haulage. Under these circumstances electricity in any shape or form does not enter into any phase of his work. He is paid by results, usually "per ton," the hewing price being controlled mainly by a fixed "county average" wage. In Scotland this is now a "minimum wage."

The work of "hewing" is arduous, especially in thin seams, and, provided he gets *no less* wage than he can now earn, he has no objection whatever to having this part of the work done by machinery. The present-day miner, in fact, has a very great objection to hewing proper; this is evidenced by the stringent regulations that some colliery managers have been obliged to issue, owing to the men blasting down the coal without first "kirving," a condition known by the term "shooting fast." With mechanical coal-cutting this arduous part of his work is done for him, and he has then only to get the coal down, either by "blasting," "hewing off," or "wedging," and fill the loose coal into tubs. Hence he rather welcomes than otherwise the introduction of coal-cutting machinery, and though his price

per ton may be reduced, he is enabled to fill more tons, but in many cases this price is not low enough to allow any margin of profit to the owners on the capital expenditure required to install the machines.

Why, then, should he request that electricity be taken out of mines, which would be nothing more or less than a serious calamity? Simply because this cheapest of all systems of power transmission has been so misused, ill-understood, and so badly installed, that he has become *afraid* of it. *Afraid!* There is no other word to describe his objection to electricity. So many fatal accidents have occurred, due to the victim unsuspiciously coming in contact with some "live" part of a circuit, when, without any warning, he is struck down, apparently by some invisible force which cannot by any means be controlled. Men have been fatally injured, and although experts (?) have been called in to make examinations and tests, *no fault* has been found in any part of the machine or circuit. In view of such a state of things as this, the miner thinks that if the technical experts cannot control or explain this "electricity," he himself will have none of it. And now that the fear has got abroad that electricity may cause a serious explosion in a fiery mine, he asks, and we may say from his point of view justly asks, that it be taken out of the pit altogether. It is not electricity as an agent for the transmission of power that he objects to, but the unexplainable mystery attaching to many of the accidents caused by it. If a winding rope breaks, although lives may be lost, the reason why it broke can be ascertained. If a "blown-out shot" or a "broken safety lamp" causes an explosion, the cause may be ascertained, and precautions taken to prevent similar occurrences. But when a man simply touches, accidentally or otherwise, a piece of bare metal, and is at once fatally struck down, and when engineers and inspectors can trace *no cause*, is it any wonder that his uneducated mind is afraid to have it anywhere near him?

What, then, is to be done? The answer is simple: first, stop cheese-paring, and accepting the *lowest* tender; secondly, put the installations in charge of "certificated and qualified" engineers and make them absolutely responsible to the law—*not the colliery manager*; and thirdly, appoint competent mines electrical inspectors to see that they (the engineers) are fulfilling their duties and that the plant is safely installed and operated. But such inspectors will have to visit the colliery; go below ground; make insulation tests, and give instructions for alterations or make recommendations, if necessary. A single inspector for the British Isles is absurdly inadequate. We have no desire to be accused of a leaning towards increasing the number of Government officials; the mining industry is already heavily handicapped by Government Regulations, but some of these Regulations are bad, and especially those relating to the certificated colliery manager. Alter this, and prepare rules for the installation and use of electricity in mines, based upon intelligent knowledge of the conditions and actual practical experience.

We have hundreds of miles of tramways and railways all worked by electricity, carrying hundreds of millions of passengers annually, yet how often do we hear of fatal accidents to the men operating these? They are very few indeed, compared to accidents in coal mines. Yet it is the same electricity! But it is installed and operated by men who know what they are about. Every detail is carefully thought out and considered in all its phases by trained engineers who are alive to their responsibilities.

There is nothing wrong, or even mysterious or dangerous, in the application of electricity even in fiery coal mines, if only reasonable precautions are taken, seasoned with a modicum of common sense. At present, there is too much "cutting," dependence upon contractors, and a too-prevalent "that is good enough" sort of spirit, to make electricity in mines safe and efficient. Remedy these failings upon the lines we have over and over again suggested in these columns, and we shall hear no more of such resolutions as that noted at the head of this article.

In conclusion, if we might venture to offer a suggestion to the Select Committee, it would be that they should examine colliery engineers and electricians who have to install the plant and keep it running—men who are constantly in the pit, and who have acquired practical experience and a knowledge of the difficulties to be met and guarded against. Ask them also who ought to be responsible; and whether they have any voice in the selection of the plant. We have no doubt that some interesting and useful information would be forthcoming—if the witnesses were independent, and not primed, or under any fear of losing their job.

Short-Circuit Tests on a Single-Phase Railway.

An interesting set of experiments was recently carried out on the German State experimental railway at Oranienburg, and is reported in the *E.T.Z.* This line is a single-phase one, with the overhead wire supplied at 6,000 volts, 25 cycles. The object of the tests was, more especially, to investigate the effect of a break in the overhead wire.

The tests were carried out during damp weather. A wire was hung with one end over the overhead line, whilst the other end was moved in turn to various positions on the roof and sides of a passenger car. As soon as the switch was closed a short-circuit occurred immediately in most cases, although sometimes a second or two elapsed before a sufficient current passed to open the maximum cut-out at the station. This cut-out was set for 800 K.V.A.

When the short-circuit was moderated by the introduction of a water resistance sufficient to prevent the cut-out from operating, the point where the current was passing would gradually heat up and finally become ignited.

In some cases the carriage covering possessed sufficient resistance to prevent much current passing, but only in a single case was a position found where a partial short-circuit resulted, which, whilst failing to operate the cut-out, might have given rise to a fire. Usually, when the wire was lying on the roof without causing a short-circuit, a slight movement of the carriage would bring about a dead short-circuit. This would usually occur at the ventilators of the gas lamps, as these were in good metallic connection with the frame.

The experiments were varied by allowing the live wire to hang down and moving the carriage up against it. In this case the wire usually first came into contact with a plain wood projection, and yet a short-circuit occurred almost immediately in every case, owing to the dampness of the wood.

It was generally possible to follow the path of the current by eye as it passed along from the metal sheeting to the under-truck, jumping any gaps in its way.

The inside of the carriage also was tested by means of an electrostatic voltmeter, whilst the live wire was lying on the roof without producing a short circuit. No appreciable voltage could be discovered anywhere, even when the metal lamp support in the roof was touched.

On the whole, the experiments indicate that little damage is likely to result from a falling live wire, even in the absence of special earthing arrangements on the carriage roof.

ELECTRIC POWER IN THE WORKS OF MESSRS. ARMSTRONG, WHITWORTH & CO., LTD., MANCHESTER.

(*Concluded from page* 407.)

Any attempt at a complete summary of the purposes to which electric power is applied in the works of Messrs. Armstrong, Whitworth & Co., would be as futile as it would be bewildering, and we must, therefore, content ourselves with a description of a few of the more unusual and startling applications of electric power which have been effected. The older works at Whitworth Street are devoted principally, though not entirely, to steel manufacture, to the production of armoured plate in its various sizes and applications and the production of heavy gun armaments for military and naval purposes. Perhaps one of the most interesting applications of electric power is to be found in the armour plate erecting shop. It must be understood that after armour-plate has been treated by the various processes, the face of the plate is so extremely hard as to make ordinary drilling or other machining impossible, but when it is required to drill a bolt or other small hole, the hard face may be softened in small patches, but a little larger than the finished hole. For this purpose in the armour-plate department, an electric plate softening process has been introduced, by means of which it is possible so to soften the plate that holes as small as ¾ in. in diameter can be drilled into the metal, this softening being so local that after drilling has been completed it is found that the edges of the holes are as hard as the rest of the plate. The electric softening plant consists of a continuous-current motor driving a single-phase alternator of 40-kw. capacity. The alternator is provided with a variable field, and this with the shunt regulation of the motor is such that the voltage from the alternator is variable between zero and 300 volts. The current passes to the primary circuit of a transformer, whose secondary consists of one single turn of massive cross-section capable of carrying 32,000 amperes alternating current at a pressure of 1 to 3 volts. This circuit is interrupted by an air gap, which can be varied at will between ½ in. and 3 in., and the open ends of the secondary are fitted with massive copper ears or contacts. The whole transformer is slung from a small jib crane, so that it can be swung over the armour-plate, and the contacts brought down on the surface of the piece of armour-plate to be treated. These contacts are partially hollow, and a flexible water pipe is connected to them for the purpose of keeping them cool during operations. The distance apart of the copper shoes is varied by suitable slotted holes in them, through which bolts are passed attached to the limbs of the secondary circuit. The motor-generator is then run up and excited, and the result is that current passes across the gap through the substance of the armour-plate immediately below and between the copper shoes, bring it to bright redness in a short time. The regulation of the field of the alternator is so fine that the current can be brought down very slowly and by small stages, allowing the iron to cool slowly through a period varying from a few minutes to any time desired, and annealing the portion of armour-plate beneath to as soft a condition as is necessary for machining. This plant was specially constructed to the requirements of Messrs. Armstrong, Whitworth & Co.

Another interesting machine, which is probably unique and without a counter-part in any other engineering shop, is a machine for grinding the edges of armour plates to a true form either at right angles or at any angle of bevel with the front surface of the plate. The machine is of special construction, and consists of a transverse bed, 22 ft. long, over which a carriage is traversed by means of a screw capable of being reversed so as to give a slow reciprocating motion. On this carriage is mounted a British Westinghouse motor of 40 h.p., running at 400 r.p.m., carrying a circular stone carrier which is coupled direct. This stone carrier, which is 34 in. in external diameter, has 10 recesses in its front face, capable of carrying segmental stones of a special nature, measuring 4½ in. × 8 in. on the face. When these stones are rapidly rotating, the edge of the armoured plate is brought against them at the required bevel by means of an overhead travelling crane, which serves the machine. The rate of cutting is varied by adjusting the rate of speed of traverse, and taking out one or more pairs of stones in the wheel, and the plates and stones are kept cool by a constant stream of water. It will be seen that this is a process which can only be satisfactorily accomplished by the use of electricity, inasmuch as the introduction of shafting to operate at a high number of revolutions and power would be a matter of some difficulty, and the placing of a direct-coupled high-speed steam set on the bed would involve flexible steam piping which would be a difficult matter. At the same time it is much to the credit of the manufacturers of the motor and to the maintenance department of Messrs. Armstrong, Whitworth & Co., that in a wet grinding process of this nature, the arduous duty on the motor can be carried out satisfactorily.

Reference was made to the armour-plate rolling mill, which is probably one of the largest in the kingdom, and it is interesting to note, that although the main drive is by means of steam, the live rolls on the bed of the mill for the purpose of handling the plates easily when passing through the squeezing rolls, are driven by two 100-h.p. electric motors; this means of drive is adopted, inasmuch as quick and easy reversal of direction of the rolls is obtained by simply reversing the motor switches. There is a smaller rolling mill in another department which is entirely electrically operated by means of a 250-kw. motor running at 300 r.p.m. This motor is a 12-pole shunt motor built by Messrs. Armstrong, Whitworth at their Elswick Works, driving by means of a series of ropes on to the shafting of the rolling mill, which revolves at 95 r.p.m. The mill, which is used for rolling fine steel plates to be made into tool steel for the purpose of milling cutters, &c., is a two-high roll, 4 ft. on the face, one roll of these dimensions being used as the rolling mill, and the other for finishing. By means of a muff clutch, a third pair of rolls suitable for making bars, can be connected up if necessary. In conjunction with this plant a pair of Messrs. Craig & Donald's shears are driven by means of a compound-wound Armstrong, Whitworth motor of 10-b.h.p. capacity.

In an enclosed chamber partially sunk under ground in the armour-plate department, and suitably protected by sheets of mild steel, is a motor-driven circular saw of a very special type, and which is probably unique in the world. It consists of a plate of mild steel, 6 ft. in diameter, and ½ in. thick, with a plain edge. This disk revolves at 1,500 r.p.m., giving a peripheral speed of nearly 28,300 ft. per minute on the cutting edge. This is driven by means of a 150-b.h.p. motor, connected direct to the disk by means of a shaft running in long spherical bearings, lubricated with oil under pressure in the same way as a turbine shaft. In view of the enormous speed, and consequently high inertia of the revolving mass, the set takes a considerable time to get up to full speed, and for this purpose special starting arrangements of a slow speed nature are introduced. The starting switchboard is located behind an armour-plate screen at one end of the chamber provided with spy holes in order to watch the process of the cutting. The material to be cut is clamped to a carriage traversing at right angles to the motor by means of a screw, driven by an auxiliary electric motor at a proper rate of travel for cutting, which can be varied. This traverse is capable of dealing with plates up to 22 ft. in length, and a 6-in. plate can be cut at the rate of 1 ft. per hour, while at the time of our visit to the works, a 2-in. hard steel plate was cut at the rate of 12 in. per minute. The action of the saw is analogous to the older process carried out on a smaller scale in lead lapping by means of which steel, which is, of course, considerably harder than lead, can be cut by means of abrasive materials embedded in the surface of the softer material. Moreover, in the case of the cutting wheel, the point at which friction occurs is fixed as regards the steel-plate which is, therefore, rapidly raised to a condition of bright redness at that point, while the friction point is traversed along the cutting edge of the disk with a velocity equal to its peripheral speed, thereby keeping the friction surface of its disk cool.

In the armour-plate department there is another application of electric drive which is distinctly novel. In the process of oil hardening and tempering steel plates, the metal in the form of plates is first heated in furnaces to the

required degree of temperature, and then brought by bogies under an electric crane of 75 tons capacity, and 50 ft. span. The distance between the ground level and the crane hook at its top position is 40 ft., and the function of the crane is to lower the glowing plate edgewise into a huge tank of oil. The usual weights of metal carried are up to 50 tons, and the speed of lift is about 12 ft. per minute, obtained by means of a compound-wound direct-current hoisting motor of 75 B.H.P. It is, however, necessary to drop the metal at a considerably greater speed than this, and for this reason, previous to the weight being lifted, oil is pumped into a large dashpot cylinder, the plunger of which is pressed down before the hook and weight rises. When the time comes to lower the plate into the oil bath, the hook and weight is released from the electrical gear, and the weight falls at a rate nearly equal to the natural drop against the oil dashpot, which, however, eases the strain of stopping the fall. In addition to the hoisting motor, electric drive is installed to operate the traverse, travel and oil pump of the crane.

The plate furnaces in this section of the works have bottoms for the reception of plates to be heated, constructed in the form of cars or large bogies, which are operated by means of 50-H.P. capstans having compound-wound motors giving a speed of 120 ft. per minute on the ropes. Electric capstans are used exclusively in the armour-plate department for handling the loads about the floors of the works.

For the water treatment of armour plates, Messrs. Armstrong, Whitworth & Co. have erected a very fine equipment of sprinklers which is capable of dealing with plates up to a size of 12 ft. × 20 ft. The plate is placed horizontally in its heated condition, on a number of carriers so formed that both the upper and lower surfaces of the plates are exposed to the rapid cooling action of the water-sprays playing upwards and downwards against the heated steel surfaces. The upper series of sprays is mounted on the carriage which is capable of being traversed till it is over the plate which has previously been placed in position by an overhead travelling crane. The traverse is operated by electric motive power, and water is conducted to the upper sprays by means of a flexible pipe. In connection with the water cooling plant of this description, is a water pumping plant consisting of six motors of 60 B.H.P., coupled to centrifugal pumps made by the Pulsometer Co. The motors are started through liquid resistances, and run at 500 R.P.M., driving the pumps against a head of 40 ft. provided by a water tower. Water storage is provided under the pump house of sufficient capacity to ensure that at no time shall the water used in cooling the plates and returned to the storage tank become warm. Two electric travelling cranes serve this plant. The cranes, which were made by Messrs. Craven, are of the three-motor type, capable of lifting 75 tons, and have a span of 75 ft.

The heavy hydraulic machines in the armour-plate department are worked by a central pumping plant, which is particularly interesting to electrical engineers. This consists of two duplicate sets of three-throw horizontal ram pumps, made by Messrs. Davies, and capable of delivering 60 gallons of water per minute against the hydraulic accumulator pressure of 25 cwt. per sq. in. These are driven by two 150-H.P. continuous-current motors running at 450 R.P.M. and geared by means of spur wheels and pinions to the pumps. The motors are started and stopped automatically, the running current being about 550 amperes, and the starting current rising to 760 amperes, inasmuch as the pump has to start against the full pressure on the rams. In order to cope with heavy current, the solenoid main switch is divided into three sections in parallel with one another. The first solenoid starter, on closing, immediately energises the coil of the second section, which at once closes and brings into instant action the third section. The convenience of this distribution of breaking circuit is obvious. To guard against a heavy arc on the third contact in breaking, this is furnished with carbon breaking tips. In series with these main switches is the main starter, the contacts of which are arranged in three segmental sections. This starting switch is operated by a small motor working on a toothed segment by means of a worm connected to the motor by a universal joint. The worm is lifted into contact with the toothed wheel by means of a solenoid energised by the closing of the third main switch. The action of this solenoid also closes contacts in the starter motor circuit. On the full travel of the starter having been made a pair of contacts on the starter arm short-circuit the armature of the starter motor, the current only flowing through the high resistance field coils. By this means over-running is prevented. The board, containing two sets of the above gear, is also provided with two overload circuit-breakers, one on each pole, two field break switches with discharge resistances, and two selector switches, one of which selects the motor which is to be operated, and the other provides a means for changing from automatic to hand-starting should this be required. For the latter purpose a hand-starter is provided for each motor. It is also possible by using the first selector switch, to put the two motors in parallel operation. The solenoid of the first main switch, which, it will be seen, commences the cycle of operations on the whole board, is in circuit with a knock-over switch adjacent to the hydraulic accumulator, and is thrown over by tappets or stops placed on a rope attached at its top to the ram, and kept stretched over the pulleys by a counterweight. This plant, constructed by Messrs. Armstrong, Whitworth & Co., has worked so successfully that another similar installation, operated by 250-H.P. motors against a pressure of 30 cwt. per sq. in., has been installed for use in the steel works department.

In the armour-plate machine department, a number of very fine special tools are installed. Reference can only be very cursory. For example, a line of six armour-plate cross-cutting machines are installed for cutting the ends of the plates and general parting-off processes before passing the steel through the hardening treatment. Each machine is fitted with a double tool capable of taking 40-ft. cuts. These machine tools were especially built for the service by Messrs. Armstrong, Whitworth & Co., and are each driven by a 20-B.H.P. motor. Another example of heavy machine tools is a double-headed drilling machine capable of drilling holes

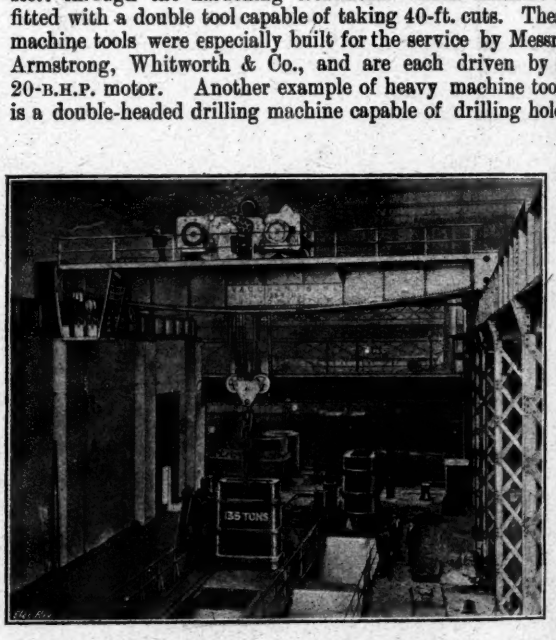

Fig. 5.—125-Ton Four-Motor Crane.

in plates up to 3½ in. diameter on any part of a plate measuring up to 15 ft. × 30 ft. This is driven by a 20-H.P. motor constructed by Messrs. Armstrong, Whitworth & Co. at their Elswick works.

Several examples of electric cranes have already been mentioned, and it may be said that this firm has made almost universal use of electricity for this purpose. As further examples of the varying capacities may be mentioned, a 125-ton four-motor crane of 51 ft. span, constructed by Messrs. Vaughan & Sons, Ltd., and illustrated in fig. 5; two 230-ton electric cranes by Messrs. Vaughan & Son; and one 150-ton crane by Messrs. Armstrong, Whitworth & Co., each of which is driven by a three-motor equipment in the armour-plate erecting shop.

In addition to steel manufacture, which can only be incidentally mentioned here, and the armour-plate works, the equipment of which has been described in some detail, Messrs. Armstrong, Whitworth & Co. have at their Whitworth Street works an extensive heavy gun-making

department devoted principally to making the 12-in. guns which form such an important part of the modern equipment of our Navy. It is served by two 30, two 50 and two 75-ton cranes, and a feature of this shop is the way in which individual electric drive is incorporated in the design of the

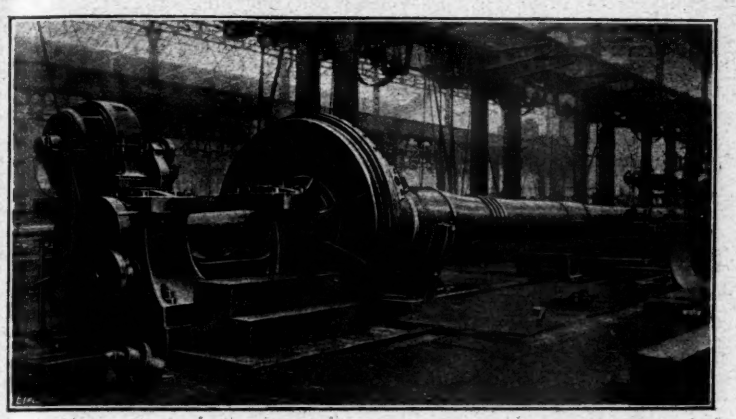

Fig. 6.—Motor-Driven Gun Lathe.

heavy lathes, rifling machines, &c. For example, in the second bay of this shop are three large lathes for gun turning, on each of which are mounted direct on the lathe motors of 60 H.P. each, of the interpole type, capable of giving a three to one speed variation on the motor alone. This dispenses with a large amount of gearing, back gearing being done away with altogether, and the rigid fixture of the motor to the lathe gives a positive drive which is impossible in any system of belt gearing. Fig. 6 illustrates one of these gun lathes, and shows the exceedingly simple manner in which electric drive is applied. Another interesting tool in this section is that used for rifling the bore of these heavy guns. The bed of this machine is 74 ft. long, and is traversed by a tool mounted on a cutter bar, which passes up the interior of the bore to the recess for the shell immediately in front of the explosion chamber. The tool is then drawn backwards, a feed having been given to it, and at the same time is rotated slowly, so as to give a spiral cut in the interior surface of the bore. The reversing of the tool is accomplished by means of a drum type switch at the end of the bed, which changes the direction of current in the armature at the end of each stroke. The starting resistance of the motor is inserted in series with the armature at each reversal, and is cut out by a special switch, which is driven off the motor shaft. The reversing switch has also an attachment for putting resistance in series with the shunt field winding of the motor in such a manner that, on the return of the stroke, the motor runs at 900 R.P.M., whilst on the cutting stroke it only runs at from 300 R.P.M. up to any speed, not exceeding 900 R.P.M., that may be required.

It will be understood that in a works of this description and magnitude, the joiners' and pattern makers' department has attained considerable dimensions, and in this section the principle of group driving is largely adopted. For operating the principal machines in this department a 50-H.P. shunt-wound motor has been installed.

Messrs. Armstrong, Whitworth & Co. have designed a special motor starter, an example of which is to be found in this department, and which may fittingly be described here. Fig. 8 illustrates the way in which it is applied to one of the line shaft drives. This starting controller, made at the Manchester section of Messrs. Armstrong, Whitworth & Co., has been designed with regard to the required conditions for the starting and protection of the motor, and also for the protection of the mains supplying the motor. It presents no particular difficulty in operating, hence it can be operated by any person without doing any damage. The upper portion of the switch consists of an adjustable overload circuit-breaker on the positive pole, and a no-volt circuit-breaker and an enclosed fuse on the negative pole. Below this apparatus is the starting switch itself, which consists of a number of copper blocks, to which the resistance connections are made. Traversing over these blocks is a laminated copper contact, suitably insulated and fastened to an iron block. The iron block is threaded, and is controlled by a screw, extending the length of the copper blocks and supported by a framing at each end. The screw is operated by a hand-wheel fixed on the end of the spindle. There is also an interlocking device on the negative circuit-breaker, which renders it impossible to close this circuit-breaker unless the sliding block be in the starting position. All the above apparatus is fixed on a slate slab mounted on an iron frame. The resistance is placed underneath the apparatus, and is made up of asbestos-woven net resistance plates. It is designed so as to give a suitable starting current on the first resistance block, and a regulated increase of current on each of the remaining blocks. The connections necessary are all made at the back of the controller. The whole of the controller is enclosed in an iron case, with movable glass front, the handles for the operation of the circuit breakers, and the starting switch, being the only parts of the controller projecting through the iron case. This type of controller has been installed in various departments of the works, and has given general satisfaction.

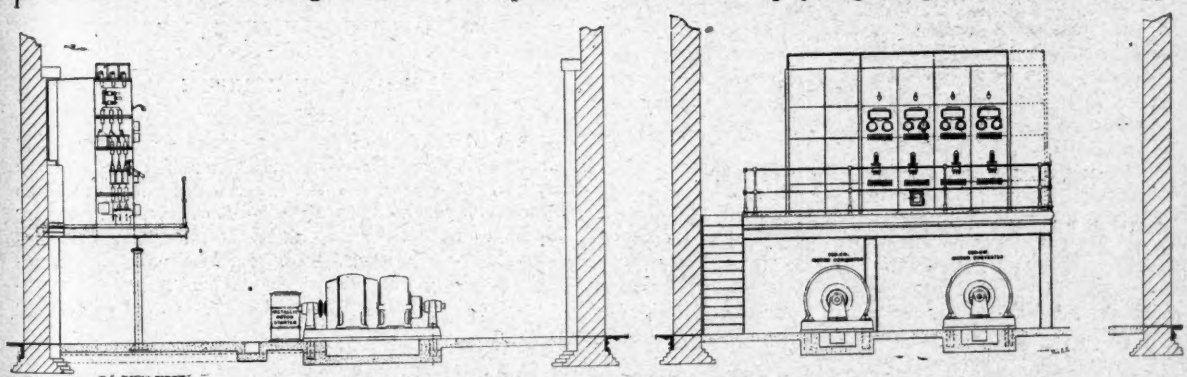

Fig. 7.—Sectional Elevations of North Street Sub-station.

An item worthy of special mention is a 50-B.H.P. shunt-wound motor, situate in the armour-plate department, which proves to be interesting as having run for several years on an exceptional duty. On being started after August Bank Holiday, it is never shut down again until Christmas Eve, and it has stood up to this work, with similar long runs between holidays, without giving any trouble for 10 years.

Within the last two years the increasing operations of the firm have necessitated still further extensions, and a new and extensive works at North Street has recently been erected in order to deal with light gun manufacture. The two works are joined by means of a full-gauge railway line which runs through the by-streets near to the works and across the main thoroughfare known as Ashton Old Road. This is used for the transport of raw and finished materials between the

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two works. The power requirements are met entirely by municipal electricity, a Corporation sub-station for the purpose being installed closely adjacent to North Street, the general lay-out of which is shown in fig. 7. Supply is given by means of three-phase current at 6,500 volts, 50 cycles, to a similar high-tension board to that installed at Whitworth Street. The energy is transformed by means of Bruce Peebles-La Cour converters of 250 KW. capacity to continuous current at 500 volts. A three-wire low-tension network is carried throughout the works, and power is obtained from the outers, while lighting is drawn from either outer and the middle wire. Up to the present four motors of 50 B.H.P. drive the shafting in the new light gun shops, while two motors of 20 B.H.P. each drive mills for the buildings department. The motors in the gun shops are mounted at the centre of each bay. The works are lit by 50 enclosed arc lamps, run two in series across the 250-volt supply. There are four bays in this new shop devoted to machining, and one to erecting; the last-named bay is dominated by a 3-ton motor travelling crane built by Messrs. Vaughan & Son. The whole of the motors used in this part of the works were

Fig. 8.—Line-Shaft Motor and Controller.

constructed by Messrs. Armstrong, Whitworth & Co., Ltd., at their Elswick Works, and it may also be mentioned that the low-tension board in the sub-station is of their own manufacture, having been constructed at their Openshaw Works.

Part of the ground area at North Street is taken up by the stockyard of the firm, and in order to handle the steel ingots and other material, a large Goliath crane of 75 tons lifting capacity has been installed. This crane runs on rails 500 ft. long, and having centres of 52 ft., the height from crane to rails of the traversing carriage being 25 ft. The main hoist is operated by a 40-B.H.P. motor capable of lifting the load of 75 tons at a speed of 5 ft. per minute, while the traverse of the carriage is driven by a motor of 15 B.H.P. at the rate of 40 to 50 ft. per minute. In order to cause the crane to travel along its rails, a motor is installed at the bottom of each leg, of 11 B.H.P. capacity. It has been frequently noticed in cranes of this description that there is considerable danger, where independent drive on each leg is used, for one leg to get ahead of the other, and to produce a joggling action on the crane, which not only causes severe racking stresses on the construction, and a considerable amount of useless friction on the rails, but also tends to oscillate the load on the hook in an unpleasant and dangerous manner. This action is more pronounced if at the time of starting the load is not slung symmetrically as regards the span of the crane. In order to overcome this difficulty Messrs. Armstrong, Whitworth & Co. have cross-connected the motors, which are series wound, so that the field of the motor at the bottom of one leg is connected in series with the armature of the motor on the other side. By this means an undue rush of current in one armature strengthens the field, and, therefore, the torque on the other motor, equalising the turning moments, and by this means an equal starting impulse on the two motors is given and maintained at all times of travel with perfect success. This system is considerably better than the practice of placing a travel motor at the centre of the span and connecting it to the driving wheels by means of cumbersome and inefficient bevel gearing. The current is brought to the circuits of this Goliath crane by means of overhead wires mounted on insulators and brackets attached to poles, spaced 25 ft. apart; a double-pole collector is placed on the crane to make contact with these wires. As the whole of the work is out of doors and subject to the severe weather conditions to be found in Manchester, it is evident that the satisfactory performance of this equipment is an evidence of the good quality of Messrs. Armstrong, Whitworth & Co.'s electrical manufacture.

The maintenance of an electrical plant and distribution system of this description calls for a considerable staff. It is probably the largest private plant and power distribution system to be found in the United Kingdom, and the supervision and upkeep in good running order of the electrical equipment requires four inspectors of plant, two inspectors of mains and a staff of 90 men, including such persons as arc lamp trimmers. These men form a self-contained department for the maintenance of the electrical work, and such constructional work as can conveniently be carried out on site.

In concluding this article, we have to put on record our appreciation of the courtesy of Mr. Gledhill, the manager of Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., at Manchester, for allowing us to prepare this description of the electrical equipment of these works, and also that of Mr. D. McCormack, the electrical engineer, for giving us a considerable amount of technical assistance in collecting data concerning the electrical apparatus which we inspected during our visit.

THE SINGLE-PHASE MOTOR.

By A. O. BUCKINGHAM.

Prior to 1900 most of the alternating-current generating stations were single-phase, and a lighting load had been the only load anticipated, but the great development in the use of power brought about by the direct-current motor for industrial purposes was not without its effect on the managers of single-phase stations, who, together with the direct-current station managers, were beginning to find it imperatively necessary to improve the load factors of their stations.

The only single-phase motors in practical existence at this time were of the simple series and repulsion types, both with badly sparking commutators and little better than academic toys, and single-phase induction motors of very low starting torque and requiring enormous starting currents, which, in combination with small, and often badly regulating transformers, failed to start at all, until assisted by hand. These offered but a poor outlook for the single-phase station in the direction of a power load; hence it came about, and not unnaturally, that a large amount of single-phase plant was relegated to the scrap heap, to be replaced by polyphase.

These radical changes, as might have been expected, were not carried into effect without leaving an unfortunate bias in the minds of engineers against the single-phase motor.

A few weeks ago the writer arrived in England after being abroad for some years, during which he had personal experience with a single-phase undertaking of considerable magnitude, which during the past three or four years has developed a growing power load of some 1,500 KW., made

up of all sizes and types of single-phase motors, which are almost without exception giving complete satisfaction to the consumers. Thus it was with considerable astonishment that he learned the adverse opinions expressed by engineers in this country as to the single-phase motor.

While prepared to admit that the starting torque of the single-phase induction motor, especially that with a squirrel-cage rotor, is inferior to that of the polyphase motor, the writer has rarely found this to be any real drawback; as power for industrial purposes is usually applied by belts to single apparatus or to countershafting, in each case equipped with fast and loose pulleys, the objection to low starting torque disappears. The writer would here point out that the fast and loose pulley system is not without some advantages of its own, especially when frequent stops are required, and the time of starting up and stopping is a consideration. Moreover, when small power is used, say up to 2 H.P. or 3 H.P., the single-phase induction motor has a peculiar advantage of its own, namely, that of running in whichever direction it is given an impulse, and for small apparatus requiring to be reversed at intervals, this fact has been fully utilised, thus dispensing with all starting apparatus, such as reactances, resistances, and phase-splitting switches; a simple D.P. switch is all that is required, the necessary impulse being given by hand.

Single-phase induction motors giving 50 per cent. of full-load torque at starting, without taking excessive current, are not uncommon.

When a large starting torque is required, the commutator type of induction motor, starting as a repulsion motor, and when up to speed automatically raising the brushes and running on as an induction motor, leaves nothing to be desired. Its characteristic is not unlike that of the series direct-current motor. It will give twice full-load torque with twice full-load current, without any other starting device than a double-pole switch. In fact, at the moment of starting, it develops the same torque per ampere as when running. The commutator is subjected to no wear, except at the short period of starting, which it does practically without any sparking. Motors of four years' continuous service show scarcely any signs of wear, and give no trouble at all.

Starting and stopping can be effected at a distance, as in the case of isolated pumping plants, and in the event of an interruption to the supply, the motor automatically arranges itself in the starting position, with brushes on the commutator; and if without an attendant, the switch being closed, it starts up automatically with the renewal of supply, resuming its normal running condition. This performance is not equalled by the ordinary D.C. motor, as the no-voltage release either opens the circuit or reintroduces starting resistance, and if without an attendant, the motor remains stopped, or in the latter case there is a danger of burning out the rheostat with the switching-on of the supply.

The absence of any need of attention, and the automaticity of starting up again in the event of interruption to the supply, especially when it is required to run all night, has frequently been a determining factor when in competition with other forms of power. Further, the single-phase commutator induction motor, in conjunction with an auto-transformer with taps, is capable of large and economical speed regulation, such as is often required by printing machinery.

As a matter of fact, it appears to the writer that there is nothing which the D.C. or the polyphase motor can do, that this type of motor cannot do equally well from the consumer's point of view. It has a high power factor, and its electrical efficiency is certainly not more than 2 per cent. below that of its D.C. or polyphase rivals.

Single-phase central station managers cannot be too careful in their selection of transformers for single-phase motors. The writer has come across transformers of 50 KW. capacity, which, when supplying full secondary current load at 70 per cent. power factor, had an inductive drop of 12 per cent., to say nothing of C^2R losses, and he is firmly convinced that many of the troubles experienced with motors failing to run up to rated output, and bad starting, are directly due to this cause.

As the undertaking with which he was engaged boasted a connected motor load of some 2,500 KW., and included all sizes of motor up to 80 KW., exclusively supplying power to 60 or 70 different trades in the area supplied, and giving every satisfaction while so doing, the writer fails to understand the *raison d'être* for the apparent backwardness of the single-phase motor in British power supply work.

HOW WE GOT THE ORDER.

By BEN FRANK.

"A SMALL white coffee and a box of dominoes, Miss."

Just as Tom gave this order, Dick entered the café. "Not a very satisfying meal for a 12-stone man," he exclaimed. "It reminds me of the tale of the spotted boy of Peru, whose father, it was said, had once upon a time swallowed a box of dominoes. What are you going to do with them, anyway?"

"Now, don't be a silly ass." Tom was evidently in a bad humour. "I suppose I *can* play solo dominoes, if I like; but, as a matter of fact, I am just waiting for Harry—and here he comes."

A glance at Harry's face, as he wormed his way between the tables to where Tom and Dick were sitting, showed that he was on good terms with himself. He was all smiles.

"What ho!" was his cheery greeting, as at length he came alongside. Tom shuffled the dominoes in glum silence. "How do," returned Dick, "had a stroke of luck, or what? You look as pleased as though you had found a sixpence."

"Ah, ha! my boy, What ho!" Harry's vocabulary was distinctly limited, but there was no mistaking his good spirits.

"I suppose Tom has told you that we have just taken the order for what's his name's big motor installation?"

"Never a word. So that's what has put you off your feed, is it Tom? I wondered what had upset you."

"It's a mug's game anyhow," Tom muttered.

"What is?" queried Harry.

"Why, doing work for nothing; it's no good to you or to anyone else. We were pretty slack or we should not have put in such a cut price as we did. We made sure of getting the job, and your firm were the last people we should have expected to be below us."

"Dash it all, you need not be quite so down hearted about it, old chap. Buck up, you'll get the next big contract."

"He seems to take it rather badly," remarked Dick, after Tom had left them.

"Yes, he does seem rather cut up about it; you see, it is not so much for the sake of the job itself, although that is well worth having, but the fact of being able to say we are doing Carmine's works means a great deal. People in their trade follow each other like sheep."

"From what Tom says, you won't make anything out of it."

"You bet we will though. If you won't say a word, I'll tell you how we got the contract."

"Right, fire ahead."

"Well, I made out the estimate and filled in all the schedules of prices. The consulting engineer is a decent sort, but a regular demon for schedules. There is a complete bill of quantities made out, and a schedule of every yard of cable, every motor, bedplate, switch, gear, belt, and goodness knows what all, so that at the end of the job it can all be measured up and charged accordingly. Of course, the tenderer has to fill in his lump sum price in the 'form of contract' for the whole of the quantities specified and agree to additions or deductions being made at schedule prices.

"Very well; I made the total come to £5,625, and this was carefully checked by one of my chaps, and I sent the estimate in to the governor for approval. When it came back the figure 6 was struck out, and a 4 put in its place, making the total £5,425. 'Look here, young fellow,' I said to Sharpe, 'I thought you checked this.' 'So I did,' says he. 'Then how is it there is a mistake of £200?'

You see, I did not dream of doubting the governor's addition. He's a real genius at figures. I never knew a man who could sum up a long money column like he can. Two figures at a time all the way up a foolscap sheet as quick as lightning; and never a mistake! So the estimate went in, and in due course the order came. 'Just run your eye down those columns again,' I said to Sharpe, 'and see where you made that mistake of £200.' But there was *no* mistake. The two of us went over it together, over and over again, and at last I had to own that the governor, for once, was wrong. So I went down to him and said that I was afraid he had made a mistake in altering my figures, and that we should be £200 to the bad if we accepted the contract.

"'Let me see the form of contract,' he said, and when he had run his eye over it he added, 'Oh, that's all right, the work is all to be measured up and charged according to schedule. If your scheduled prices are all right, it does not matter what total you fill in the form, it won't count for anything at the end of the job!'

"'You wily old bounder!' I thought to myself. That had never occurred to me before. You see, the contract is settled on the lump sum price; but once the job is started, there will be no end of alterations, and only the schedule will count."

Dick raised his eyebrows and whistled softly. "Very smart, to put the mildest construction on it. Tom *would* feel pleased if he knew, wouldn't he?"

"Don't breathe a word to him, for Heaven's sake! Of course, it was a clerical error on the governor's part, but he made the best of it." Harry was clearly trying to dissemble.

"Of course, of course; but if that consulting engineer is as clever as you say, he's sure to spot it."

"Well, what if he does, he can't do anything, the schedule's the thing."

"I know what I should do, if I were he."

"What?"

"Oh! Never mind."

THE MEASUREMENT OF THE INSULATION OF A LIVE THREE-WIRE SYSTEM.

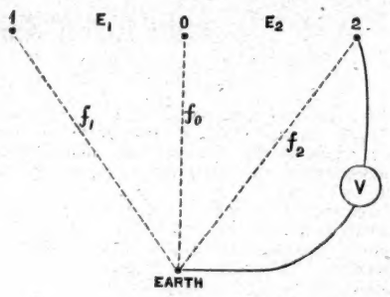
By STUART A. RUSSELL.

The interesting paper on the above subject, communicated by Dr. Kapp and Dr. Coales to the Institution of Electrical Engineers, and published in abstract in the Electrical Review of the 20th ult., describes two methods of finding the joint fault resistance of a live three-wire system with the middle wire earthed; and it further shows how, by a variation of the voltage on the two sides of the three-wire system, this joint resistance can be separated into its three components.

The credit of first working out a method of determining the three separate fault resistances by varying the voltage on the two sides of a three-wire system is due, the writer believes, to Prof. Rousseau, of Brussels University, as he proposed it to the writer in 1894 as an extension of the voltmeter test then in use for testing the cable system in connection with the Brussels Municipal electric light station. This method was described, and the proof given, in an article by the present writer which was published in the Electrical Review of February 25th, 1898; but it may be of interest to again briefly describe the method employed, as it is one that was regularly in use at Brussels in 1894.

The apparatus required consists of an electrostatic or high-resistance voltmeter, a resistance of known value, and one or more switches; and the test is made by first determining the joint fault resistance of the system, which is done by connecting any one of the three wires to earth through the voltmeter and noting the reading V, and then connecting the same wire to earth through the resistance S and noting the reading V^1. The joint fault resistance is $F = S \frac{V - V^1}{V^1}$, provided an electrostatic voltmeter is used, or a voltmeter whose resistance is very high compared with the values of F and S. It will be noted that if the resistance S is adjustable, and is regulated so that $V^1 = \frac{V}{2}$, the apparatus becomes direct reading, as $F = S$. This method can be applied at any point of the system, and it is not necessary to interrupt the earthing connection when making the test. At the same time it must be remembered that, whatever method is employed, great accuracy cannot be obtained if the resistance of the earth connection is low compared with the fault resistances of the several wires.

Prof. Rousseau's method of obtaining the separate values of the three components is as follows:—After obtaining the value of F as described above, the voltage E_1 on one side is raised, and the voltage E_2 on the other side of the system is lowered, so as to make the ratio $\frac{E_1}{E_2} = K$ as large as is conveniently possible, and the reading V of the voltmeter when connected between one wire and earth is noted. The voltage is then again changed so as to make the ratio $\frac{e_1}{e_2} = k$ as small as possible, and the reading v of the voltmeter is noted. Referring to the diagram, in which 1, 0 and 2 are



the three wires, f_1, f_0 and f_2 the fault resistances, and V the voltmeter connecting the wire 2 to earth, we have—

$$\frac{V}{F} - \frac{E_2}{f_0} - \frac{E_1 + E_2}{f_1} = 0, \qquad (1)$$

or—

$$\frac{V}{E_2 F} - \frac{1}{f_0} - \frac{1 + K}{f_1} = 0. \qquad (2)$$

Similarly, when the voltages are e_1 and e_2, and the voltmeter reading is v, we have—

$$\frac{v}{e_2 F} - \frac{1}{f_0} - \frac{1 + k}{f_1} = 0. \qquad (3)$$

From (2) and (3) we get—

$$\frac{1}{F}\left(\frac{V}{E_2} - \frac{v}{e_2}\right) - \frac{K - k}{f_1} = 0,$$

giving—

$$f_1 = \frac{F E_2 e_2 (K - k)}{e_2 V - E_2 v}. \qquad (4)$$

We can now get the value of f_0 by filling in the value of f_1, in equation (1), and when f_1 and f_0 are known, the value of f_2 can be found from the equation—

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_0} + \frac{1}{f_2}.$$

The measurements of E_1, E_2, e_1 and e_2 can be made with the same voltmeter that is used for measuring the voltage to earth, but it is more convenient to use a separate voltmeter connected through a double-pole change-over switch.

Name-plates.—We have received from the Globe Name-Plate Co., Ltd., of 20, High Holborn, W.C., specimens of their chemically-engraved name-plates, such as they are supplying to prominent electrical manufacturing firms.

AN IMPROVED FORM OF CONDENSER FOR POWER WORK.

THE undoubted opening which exists for a cheap and reliable condenser in alternating-current distribution work has not hitherto been satisfactorily met, chiefly because of the difficulty of obtaining a suitable dielectric and of building the condensers in a safe and mechanical manner.

For low voltages, such as occur in telegraph and telephone work, the recently-introduced paraffin-paper condensers, made up by winding plain paper and tin-coated paper from continuous rolls, are thoroughly satisfactory, whilst for high-tension work at 10,000 or more volts the Moscicki glass-tube condensers have given good results. For moderate voltages glass is unsuitable, as it cannot be obtained in thicknesses sufficiently small from the electrical standpoint, whilst retaining sufficient mechanical strength.

Paper is eminently suitable for the purpose, but its hygroscopic nature must be combated by some more stable and heat-resisting material than paraffin, and with this object various resinous sub-

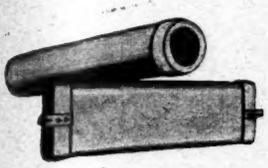


FIG. 1.

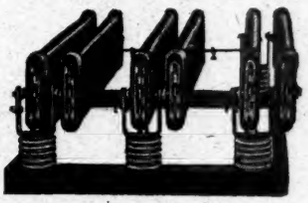


FIG. 2.

stances have been tried from time to time. The condensers were, however, usually unsatisfactory, because they were made up by hand with alternate sheets of tinfoil and dielectric, and the insufficient protection of the edges and the presence of air bubbles gave trouble.

Messrs. Meirowsky & Co. some years ago patented a machine for forming insulation tubes out of treated paper, and they have recently applied the same apparatus to the production of a reliable form of condenser. The process of forming the insulation tubes was as follows:—The prepared paper, retarded by a brake, was drawn over hot plates and wound on a mandrel working under heavy pressure from two rollers, kept at a temperature only slightly below the melting point of tin. In this way both dampness and air bubbles were effectively avoided, and the resulting tube, after cooling, was drawn off the mandrel with an extremely dense and firm texture, and in a condition to be worked like wood. The material was known as Pertinax, and was found very reliable both in air and in oil. If required, the tubes could be flattened out into plates.

When using this process for the production of condensers, it is only necessary to lay suitable sheets of smooth tinfoil on the paper as it leaves the drum and passes over the hot plates, and to wind this tinfoil in with the paper. In the direction of motion the sheets of tinfoil are made of the right length to reach just once

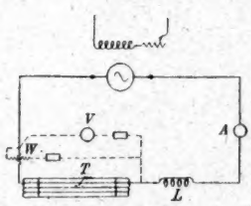


FIG. 3.

round the periphery, and the breadth of the tinfoil is made somewhat less than that of the paper, according to the voltage on which the condenser is to be used. Projecting lugs, alternately to right and left, are provided on the tinfoil sheets.

In this way, after removal from the mandrel and the joining of the lugs, a thoroughly satisfactory tube-shaped condenser is obtained without air bubbles, with every trace of moisture removed and with the edges completely closed down round each piece of tinfoil. The tube can, if desired, be pressed into a flat shape, as shown in fig. 1, although this is at the expense of the internal cooling surface. A battery of such plate-shaped condensers is shown in fig. 2. The condensers can be readily arranged to suit any voltage by simply varying the number of layers of plain paper wound on between every two tinfoil sheets.

Dr. K. Fischer, in the *E.T.Z.* for July 1st, 1909, describes some tests carried out on condensers of this type. A battery of four condensers, suitable for 1,000 volts, was made up, each element having a capacity (measured with direct current) of from 1·72 to 2·28 microfarads (total, 8·25 mfd.), a weight of 3,840 to 4,490 grammes (total weight, 16,500 grammes), and a size of 75 cm. × 14·8 to 16 cm. × 2·5 to 2·75 cm. (total volume, 10,902 cb. cm.). They were of the flat shape, and were laid one on top of the other, and the temperature during the test was taken in between the two central ones at T (fig. 3).

As no 1,000-volt supply was available, the test was carried out by arranging a resonance circuit as in fig. 3, using a transformer for the choking coil L, and adjusting it until the voltage v was about 1,000. The wattmeter w was of the dynamometer torsion-head type; the voltmeter was a Weston dynamometer, and the ammeter a hot-wire instrument. The condenser was run for 5½ hours at a voltage varying between 990 and 1,160, the supply voltage being about 300, and the frequency varying from 87 at the start to 69 at the end. The power absorbed by the condenser was about 50 watts, and the power factor varied from ·09 at the start to ·12 at the end. The capacity, calculated from the alternating measurements by the ordinary formula, was 8·7 mfd. at the start, and 9·3 mfd. at the end. The temperature rise at T at the end of the run was 19½° C., and was practically steady at that.

After this test the condensers were connected to a H.T. transformer, and the voltage was gradually raised. At about 2,000 volts the noise of a slight discharge was noticed. This increased with

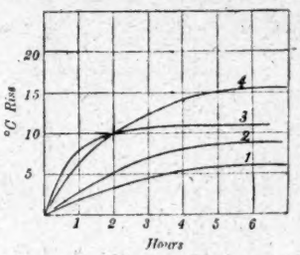


FIG. 4.

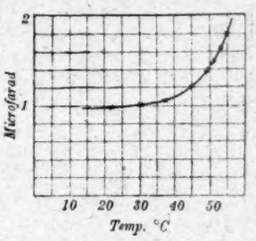


FIG 5.

the voltage, and breakdown of one element occurred at 5,500 volts. An examination of the inside of the condenser showed the presence of a blackened cavity.

The insulation resistance of these transformers was practically infinity when cold, and even after lying for some hours in water, although the resistance fell, they stood the full voltage satisfactorily.

Various transformers for higher voltages up to 10,000 were also tested, and all showed a power factor of about ·1 at 50 cycles. Fig. 4 shows the temperature rise curves for some of these. Curve 1 is for a 10,000-volt ·022 mfd. condenser, curve 2 for a 5,500-volt ·082 mfd. one, curve 3 for a 3,000-volt ·22 mfd. one, and curve 4 a 2,000-volt ·56 mfd. one.

The temperature rise has a somewhat marked effect on the capacity, especially at the higher values, as is shown in fig. 5. Within the ordinary range of temperature, however, this variation is not appreciable.

ELECTRICAL DEVICES FOR HANDLING MATERIAL AT GARY.

ONE of the most prominent features of the equipment at the Gary plant of the Indiana Steel Co. is the apparatus provided for handling the raw material. Along the slip where the ore is received in vessels, there are five monster ore unloaders and an equal number of bridges. Each unloader is of the grab-bucket type rated at 10 tons per lift, while each bridge is rated at 13 tons and is of the cantilever type. The former is equipped with six motors, having a total rating of 435 H.P., while the latter has 14 motors, the aggregate rating of which is 618 H.P. The object of the bridges is to convey the ore to the point of use from a large concrete trough to which it is carried by the unloaders.

The master controller for operating the six motors on each unloader is mounted in a motorman's compartment arranged within the leg of the unloader immediately above the bucket; thus the operator is able at all times to view the performance of the machine from the most advantageous position. No power other than that derived from electricity is used with the unloaders, all hydraulic cylinders, &c., having been dispensed with. Lifting magnets have proved particularly advantageous for handling both the raw material and the finished product at Gary. In the open-hearth stockyards, the cranes used for unloading pig-iron and scrap from railroad cars are equipped with magnets provided with a controller so arranged as to cause the load to be released with great promptness. Current in a reversed direction is sent through the magnet winding when it is desired to release the load. It is said that the load is released in 0·6 second, while when this arrangement is not used 12 seconds are required for releasing the load. Skull-cracker cranes equipped with lifting magnets are in use at the open hearth and adjacent to the pig-casting machine for breaking up defective castings and the skulls of chilled metal which accumulate on the linings of ladles used in handling molten metal. The cranes are mounted upon runways of exceptional height. Steel balls weighing approximately 12,000 lb. are used for breaking up the scrap and skulls. The material to be broken is unloaded from cars and placed on the ground by means of the magnet. A ball is then lifted by the magnet and hoisted to a suitable height, and merely throwing the magnet controller to the "off" position releases the ball, which does the work of breaking the material. The broken metal is then gathered

up by the magnet and loaded into boxes for charging into the open-hearth furnaces.

There has recently been put into operation at Gary a pair of lifting magnets for handling the output of the rail mill. The shipping yard of the rail mill is spanned by two special electric cranes, each equipped with double hoisting drums. Fig. 1 illustrates a pair of magnets suspended from one of these cranes lifting 30,000 lb. of rails 60 ft. in length; the same pair of magnets are capable of lifting a double-locked or nested layer of rails 30 ft. in length, 23 rails being handled at each lift. In other words, 10 or 12 tons of rails are handled per lift, depending upon the section of the rail. With these magnets an ordinary car of rails can readily be loaded in from two to three minutes. In addition to the saving in

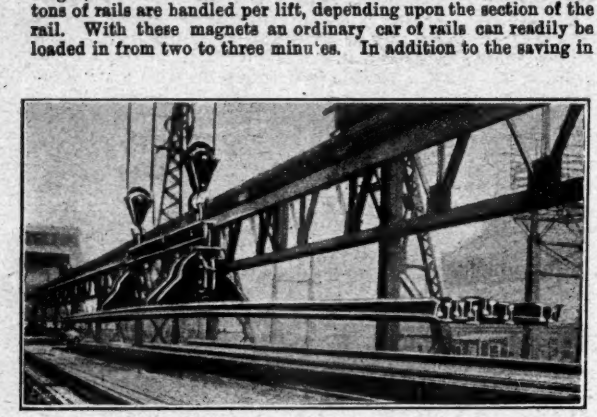


Fig. 1.—Electromagnets Lifting a Layer of 60-ft. Rails.

time and labour which is introduced by these rail-handling magnets, a further advantage is gained in that owing to the wide spacing of the magnets the rails are not strained, and there is no danger of giving them a permanent set in the process of handling.

For controlling the motors on the above-mentioned cranes, as well as those on the ladle cranes, charging cranes, soaking-pit cranes, stripper cranes, &c., use is made of ventilated grid controllers of the type devised by Mr. A. C. Dinkey when superintendent of the electrical department of the Homestead Steel Works. The controller is operated by a lever having a straight forward and backward motion. When properly connected, the motion of the lever indicates to the operator the direction in which the motor will run. For instance, in the case of a trolley on a crane, when the operator moves the lever from him the trolley moves across the bridge away from him, and when the lever moves toward the operator the trolley moves toward him. This agreement is found to be very valuable, particularly in cases where one operator must operate a number of controllers, and where confusion on the part of the operator might result in serious damage.

The above-described controlling devices and lifting magnets were designed and built by the Electrical Controller & Manufacturing Co., Cleveland, Ohio.—*Electrical World.*

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Storekeeping for an Electricity Works.

May I briefly reply to the letter by "E. W. R.," which appeared in your issue of September 3rd? I will take the notes one at a time:—

1. I much prefer a book for the requisition of goods to the loose leaves torn from a carbon copy book.

2. The only difference suggested here is a hand-ruled book in place of one with the headings printed.

3. "E. W. R." hardly makes his meaning clear in this paragraph. I do not see any reason why the storekeeper should not keep the stores cards. A card is used for each article, or batch of like articles, because experience proves that to be necessary. There are storekeepers and storekeepers, and their knowledge of electrical material may vary in proportion to their positions and salaries. In an electricity works the storekeeper has to deal with scores of other goods than electrical material.

4. The cash columns in the stores book (received) are not there for use by the storekeeper. The cash columns serve a particular purpose peculiar to an undertaking where the borough accountant handles the financial part of the business. I do not agree that the storekeeper should be responsible for *all* goods passed by him. The engineer is the man who knows what he requires.

5. The £ s. d. columns in the issued book are there for the benefit of the cost clerk. "E. W. R." says here "for the same reason as No. 4." No reason appears in "No. 4," only a question.

The few books and cards described really form part of a complete system of cost keeping. Perhaps this should have been mentioned; the presence then of any superfluous matter might have been understood, where the use was not apparent. With regard to the remarks about a difficulty being experienced with such a large number of books, practice says otherwise.

Interested.

The New Theory of Electricity.

Your correspondent Mr. Walker will, I think, find it a great advantage in understanding the new theories of matter and electricity if he becomes a Berkeleyan out and out. Clerk Maxwell, as we all know, wrote:—"Bishop Berkeley let us d—n him with faint praise," but I doubt greatly if his successor at Cambridge, Sir O. Lodge, and others, would have the temerity to do so.

Meanwhile people like the writer live in a medium 2,000 million times denser than lead, where masses are not acted upon by gravitation, and of which the only point in its favour, is the childlike simplicity of the mathematics compared with earlier times. Mathematical physicists nowadays calculate densities of ether, &c., as easily as Hudibras spouted Greek. If it does not look quite right the theory soon straightens things.

"All mass is mass of the ether, all momentum momentum of the ether, all kinetic energy kinetic energy of the ether," so writes Sir J. J. Thomson in "Electricity and Matter," a book I recommend together with "the little Berkeley," to Mr. Walker.

"We are all waves" writes another scientist, and "molecules are individuals;" having got so far, it is but a step to do as the writer has done, and believe with good Bishop Berkeley that everything is merely "an apparition of the mind."

Anyone who wishes to appreciate the modern theory of Thomson, Drude, &c., as regards matter, or rather its absence, would be well advised to study Berkeley first.

Meanwhile the grand simplicity of the corpuscular mathematics is, like the Bellman's chart in the "Hunting of the Snark," something to be thankful for. Previously it was about as bad as the good Bishop's "brandy and salt" cure for all ailments; and when one turns oneself inside out, so to speak, the regions spoken of by Sir O. Lodge recently become apparent. Places—

"Where entity, and quiddity,
The ghost of defunct bodies fly."

Physics now is much more exciting reading than anything Wells or Marie Corelli can produce.

M. F. H. W.

I beg to thank you for your courteous reply to my letter on the above subject, which appears in the current issue. I am also interested to learn that you champion the new theory. May I ask you to carry the matter a little farther, and to state the experimental proof of the claim made by Sir Joseph Thomson, and endorsed by yourself, that the whole of the mass of the corpuscle arises from its charge?

My complaint in this matter is that Sir Joseph Thomson, and those who think with him, have jumped an important gap in the chain of evidence. Taking the report of Sir Joseph's address, given in your own columns, I note the following:—

The study of gases exposed to Röntgen rays has revealed in such gases the presence of particles charged with electricity; some of these particles are charged with positive, others with negative, electricity.

The properties of these particles have been investigated; we know the charge they carry, the speed with which they move under an electric force, the rate at which the oppositely charged ones recombine, and these investigations have thrown a new light, not only on electricity, but also on the structure of matter.

We know from these investigations that electricity, like matter, is molecular in structure, that just as a quantity of hydrogen is a collection of an immense number of small particles called molecules, so a charge of electricity is made up of a great number of small charges, each of a perfectly definite and known amount.

With practically all of the above I should be in agreement, except that I should look for proof of the claim that the investigations have thrown a new light on the structure of matter. Later on in the address, however, I find the following :—

We have already made considerable progress in the task of discovering what the structure of electricity is. We know that negative electricity is made up of units, all of which are of the same kind; that these units are exceedingly small compared with even the smallest atom, for the mass of the unit is only $\frac{1}{1700}$ part of the mass of an atom of hydrogen; that its radius is only 10^{-13} centimetre, and that these units, "corpuscles" as they have been called, can be obtained from all substances. The size of these corpuscles is on an altogether different scale from that of atoms; the volume of a corpuscle bears to that of the atom about the same relation as that of a speck of dust to the volume of this room. Under suitable conditions they move at enormous speeds which approach in some instances the velocity of light. The whole of the mass of the corpuscle arises from its charge.

In the whole of the last quotation from the address, which I take it gives the substance upon which you endorse the President's claim, it will be noted that there is no proof of the claims made. The President makes very large claims, I think it will be acknowledged, and I ask, where is the proof of the claims?

Suppose we analyse the claim you quote. Newton's definition of mass, it will be remembered, is volume into density. How does the volume or density of the corpuscle arise out of the charge which it carries? The point which I wish to make is that, so far as anything which has yet appeared shows, Sir Joseph Thomson, and those who think with him, have assumed, without proof, that the charged corpuscle is the charge. I ask for proof of it.

Assuming that the charge controls the volume and density of the corpuscle, surely that is different to the corpuscle owing its existence to the charge. Many substances owe their volume and density to their possession of a certain quantity of heat, yet I presume it will not be argued that heat is, for instance, steam.

Sydney F. Walker.

Bath, *September 13th*, 1909.

[It is not usual, when recording conclusions, to recapitulate the whole of the evidence upon which they are based; the limitations of time and space preclude any such attempt. Our correspondent will find the details of the experiments recorded in the proceedings of the scientific societies and other publications. He appears to have heard of them now for the first time, and seemingly has not kept himself in touch with the investigations which have been in progress in this connection during the past decade.—Eds. E.R.]

What is an Electrician?

In reply to "Alpha," what constitutes an electrician, I would like to say that up till a year or two back I was always under the impression that an "Electrician" was one versed in electricity, not necessarily a lathe and vice man nor even a mechanic, but one who had a good technical knowledge of the subject and was able to direct the installing and erection of electrical plant only. On the other hand, an electrical engineer was one who had passed right through the works and was capable of erecting and running a complete plant, including boilers and prime movers, being a thoroughly practical man, with good technical and a fair commercial knowledge of both steam and electrical machinery. However, like "Alpha," my ideas were shattered a year or two back after reading an advertisement in your paper, which no doubt many of my electrical friends will remember. It read after this style :—

"Wanted, an electrical engineer to take charge of the electric light plant on a gentleman's estate; one who could do horse-shoeing preferred; must be a married man, with a wife able to milk. Salary, 22s. per week, with cottage, coals, and potatoes." What O! the potatoes.

Some little time later another one appeared, viz. :—

"Wanted, an electrical engineer, married, for private estate in the Isle of Bute, to take charge of the electric light installation, run electric launch on lake, also a steam launch between island and mainland, one with a knowledge of motor-cars preferred."

Now, being an all-round man, I answered this, and after a week's delay, I received the following reply. "I am instructed by the Hon. So-and-So to state that your experience being that of the man we require, we shall be glad to know if you could commence duties on 26th inst. The salary will be 27s. per week, with house, garden, and coals."

However, I was so nervous of the salary, I did not accept it.

I often wonder if our dear old Editor inserts these adverts. for the enjoyment of his readers, or whether he's really in earnest. But, when all's said and done, I suppose we mustn't grumble, because who knows but that some day one of the above jobs, combined with the Old Age Pension, may keep one of us out of the workhouse.

C. W. Wardle.

Newcastle-on-Tyne, *Sept. 13th*, 1909.

[We hardly need point out that we are in no way responsible for the announcements that appear in our advertisement pages.—Eds. E.R.]

The opinions of "Alpha" upon this question have been perused with interest. The term "electrician" is quite authentic. If we look in the dictionary, we see that an electrician is one versed in the science of electricity. Now, the trouble is that not everyone who styles himself an electrician is versed in the science of electricity. Let us take two extremes.

There is, say, the local plumber and gasfitter, who has no technical knowledge of, or practical experience in, electrical work proper, but who will fix an electric bell for you, and is not above attempting electric light wiring (despite the resultant low insulation test, &c.). He is an "electrician." Then we peruse a syllabus from that eminent gentleman, Prof. Andrew Jamieson, and find that he is "consulting engineer and electrician."

Thus we have the two extremes enclosing Messrs. Nobody, Anybody, and Everybody. No one can call himself "Doctor" unless he possesses the necessary qualifications for such distinction. Anybody can term himself "electrician," whether he possess the necessary qualifications or not. The qualifications which an electrician should have are a good combined practical and technical knowledge of the branch of electrical work to which he devotes his efforts.

An electrical engineer is, of course, one who has a thorough all-round knowledge of electrical work. Having passed the recognised examinations of the City and Guilds of London Institute (either for wiremen and electricians, or for electrical engineers) should be recognised as adequate technical qualification for those who have been unable to take a day course at one or other of the technical institutions.

In regard to wiremen, arc lamp trimmers, motor attendants, &c., they are all necessary adjuncts to the efficient working of an electrical concern where they are employed, otherwise they would not be there, and there are many amongst these who can quite correctly style themselves electricians, whilst as regards those who do style themselves electricians and electrical engineers, and are not entitled to do so, well, we cannot, under the present conditions, prevent them from doing so; therefore, it is only left for us to quietly smile (or frown) at the presumptuousness of such individuals.

R. W. J.

Electric Miners' Lamps.

Mr. Jones's criticism of my letter in your last issue has caused me to go more fully into the case for electric miners' lamps, with the result that I am myself surprised to discover how good and strong a case it is.

Referring to Mr. Jones's letter, however, I should like to say it is news to me that the Joicey Collieries and the Lambton Collieries are under joint control; I am, therefore, corrected in this matter.

With regard to the Ediswan bulbs, my information is from the very best source, but as I have not the permission of the colliery proprietors to publish their figures, I cannot do so; but Mr. Jones can rest assured that these lamps have proved the most satisfactory, in spite of many tests with other lamps for quite a number of years.

With regard to how many collieries can take 2,000 miners' lamps, I may say that, without an effort, I can think of at least a dozen, and although I do not profess to be a mining engineer, I think there must be many others of quite as large a capacity.

Mr. Jones, I think, leaves out of consideration in his estimate of costs several items.

1. The parts he mentions, and for which he allows 1d. per lamp per week, are practically eliminated from my battery, and the broken glasses are paid for in many collieries, by the miners, &c., themselves. For instance, I eliminate battery plates, flexible connectors, either worn-out or broken lugs, ebonite cases, charges for distilled water and lead rivets, and reduce the consumption of sulphuric acid to the very lowest.

2. The bulbs have a life of 1,000 hours, and cost little more than half the figure that Mr. Jones quotes.

3. With regard to plant required, I would point out that electricity is now generated at most of the large collieries throughout the kingdom at a very low cost, or else it is obtainable from the district electricity supply at not more than 1d. per unit.

4. I cannot see how 2,000 lamps, charged in three batches, and requiring 1¼ watts each (even assuming that the maximum current is being used during the whole six days) can possibly consume more than 120 B.T.U. (not 400 B.T.U.) per week, and certainly a generating plant of 5 KW. would be just about five times as large as would be required to charge 666 lamps per time, and leave a margin for charging another 100 lamps.

By my improved design of lamp and system of working, the existing lamp cabin and staff can, in most cases, be utilised for the electric lamps, and I claim that my cost for repairs and up-keep is *less* than with the oil lamp owing to the elimination of working parts, reduction of inspection and insurance expenses, not to mention the absence of fire risk, the use of metal-filament lamps, hermetically sealed cases, and interchangeable parts, most of which can be bought by the million in the open market.

Although the first and running costs of my lamp are much below that of any other electric lamp I happen to know about, my reason for writing to your journal was, as stated in my first letter, more to point out that any satisfactory electric hand lamp offers important advantages to colliery managers and men quite apart from lamp cabin economies. The advantages are precisely :—

Absence of fire risks through defective, overheated or damaged gauzes and broken glasses or unlocked Davy lamps.

Decreased expenditure for inspection and supervision. (If the time of 10 men at £2 per week is diverted to other functions in the colliery, £20 per week should be written off the lamp account.)

Cleaner coal, owing to a whiter light.

Better atmospheric conditions for the hewers.

Moreover, I am possessed of definite knowledge that in the case of one colliery using electric hand lamps, the accounts show an appreciable balance in favour of running electric lamps as against Davy lamps, while if the decreased insurance rate is considered, our (the electrical engineers') position is impregnable. One gas catastrophe averted would financially outweigh the first and maintenance costs of many electric lamps for many years to come.

I am somewhat surprised and disappointed that Mr. Jones has not supported us more in his arguments than he has done.

Fred. J. Turquand.

London, W.C., *September 13th*, 1909.

Tramway Power Tariffs.

Are you aware that in your leader in this week's issue you have perpetrated an extraordinary blunder in comparing tramway power station *works costs* with combined lighting and power station *works costs plus capital charges*?

Arguing on this false basis you point out the disadvantage of those tramway authorities who purchase current instead of generating it themselves. It is difficult to understand how such an extraordinary blunder could have got into your paper as it has, but you can quite appreciate the uncomfortable time that a good few borough electrical engineers will experience who are selling current to a tramway undertaking.

You are using the very argument which is used by many tramway managers and tramway committeemen, who *will not* realise the difference between works costs and total costs.

A. H. Seabrook,
General Manager.

Marylebone Electricity Supply.

[Mr. Seabrook has evidently not read the article in question throughout, or he would have noticed that after giving the *average works cost* (which includes distribution, repairs, &c.) of 12 tramway power plants, viz., 0·402d. per unit, and similarly the *average purchase price* paid in the case of 10 combined undertakings, viz., 1·147d. per unit, we stated, "It is true, these figures are not directly comparable. . . . . The higher figure includes in many cases transforming and feeder losses, as well as the interest and sinking fund charges on the capital cost of the power house, substations where necessary, and feeders."

We then go on to show that allowing for financial charges at 6 per cent. on £55 per KW., in addition to the tramways station works cost, there is still a balance in favour of the self-contained systems, amounting to no less than £160,000.

The concluding paragraphs of the article dealt with the Glasgow and Manchester undertakings particularly. Can our resourceful correspondent explain away the 1909 published data of the Glasgow undertaking, viz., 27,741,755 KW.-hours "issued from power station to sub-stations;" load factor, 39·8 per cent.; power expenses, interest and sinking fund, ·757d. per unit, or allowing for conversion and transmission losses, to meet Manchester conditions, ·82d per unit? In the case of Manchester, the 1909 figures show 29,675,249 units sold to the tramways department at 1·04d. per unit, and we have Mr. Pearce's statement at the M.E.A. last June, that the Manchester traction load factor is 32 per cent.

While it may be argued that these cases are not strictly comparable, we submit that they are sufficiently so to allow one to form an opinion in favour of the tramway plant, even allowing an addition for depreciation in the Glasgow case at the same rate as may be included in the Manchester figures.

We quite appreciate the troubles of the borough electrical engineer who runs up against a tramway committeeman, particularly if the latter should interpret the proper proportion of capital charges to be included in his price per unit, as the proportion of the capital charge incurred in giving the supply in his particular case—a definition with which Mr. Seabrook will certainly agree.—EDS. E.R.]

The ascertainment of cost of traction supply in a combined undertaking is admittedly complicated by reason of load and diversity factors and other causes, and is a matter which cannot profitably be discussed in the columns of a newspaper.

Fortunately, however, this point is not at issue, the only matters really calling for attention being, on the one hand, the prices *charged* for traction supplies in cases of combined undertakings, and, on the other hand, the costs in cases where separate plants are owned and worked by tramways undertakings.

Two such cases will illustrate the unmistakable errors made in your leader, and what is true here will, no doubt, apply to the other towns named by you. The cases can be supported with a wealth of detail, but so as not to encroach unduly on your space, the facts are given as briefly as possible. For the year 1908 you quote Manchester's charge for traction as 1·14d. per unit. This is quite correct, but note should be taken that the units charged are measured at the distributing stations, and not at the generating stations. Glasgow's cost is, however, not £37,365, or ·35d. per unit, as you state, but is, according to page 21 of the accounts issued by the Glasgow tramways department, £136,145 in all, or 1·19d. per unit, and this, be it noted, is for units measured at the generating station. As Glasgow furnishes on the same page the total units at distributing stations, it is possible to correctly place the figures on something like equality with Manchester. The total then, as issued for traction load from sub-station direct-current bus-bars, is 23,103,603 units, which divided into the £136,145 above

named, represents 1·41d. per unit, a vastly different figure from the ·35d. previously mentioned.

Your leader partly explains the discrepancy by referring to the omission of interest and sinking fund charges, but there are other omissions, such as provision for renewals, rates, taxes, management expenses, &c., all of which are included in Glasgow's own statement.

The other case is that of Sheffield, where the figures published require considerable adjustment before they are comparable with those for Manchester. For instance, Sheffield's cost of ·668d. per unit makes no allowance whatever for units used in the generating station, nor for the excess of transmission losses in Sheffield as compared with Manchester, nor for rates and taxes. From figures supplied by Sheffield, it appears these increase the cost to ·81d. per unit, and even then there is no provision for renewals, as is the case in both Glasgow and Manchester. Further, the costs in the Glasgow area, and in that part of the Manchester area worked from the Stuart Street station, are for high-tension supplies converted at and distributed through sub-stations. Consequently they are not comparable with Sheffield's cost, which is for a low-tension supply furnished direct from the generating station, the true comparison here being with that part of Manchester's supply given from Bloom Street station, where the cost is practically the same as in Sheffield.

Perhaps the best comment on these comparisons of Manchester's dual system with Glasgow and Sheffield, is to mention that they have been critically tested and accepted by the Manchester Tramways Authorities within the last few months, and there is no doubt existing in Manchester as to the wisdom of the combined supplies. Whatever may be said of other towns, it is certainly not true that dissatisfaction exists in Manchester.

It is alleged that Tramways Committees, when comparing the prices charged to them for traction with those charged to large power consumers, are not convinced that the difference in conditions warrants the difference in prices. Be that as it may, the differences in conditions of supply are incontestable, and the economics of electric supply are nowadays sufficiently well understood to render argument as to the justice of lowering prices for better load factors unnecessary. The only proof needed is that the better load factors exist, and on that point electric undertakings may be trusted to look after their own interests.

As far as the municipalities are concerned, I submit that this question should be looked at not from the tramways manager's standpoint or the electrical engineer's standpoint, but from that of the broader viewpoint, viz., which course is best for the municipality as a whole?

Referring again to the case of Glasgow, the most important undertaking cited in support of the separate generating station system, what is the position to-day? The electricity and tramway power stations are linked up by mains, enabling the two departments to exchange to the extent of 4,000 KW. In at least one other of the towns named, the question of giving a supply for the tramway extensions from the lighting station has been under serious consideration of late. I am unable to appreciate the difference between the linking up of tramway and lighting stations and a combined station to commence with; the principle involved is the same in each case, and I submit these examples afford very fair proof of the correctness of Mr. Wordingham's advice and Manchester's attitude on this question some ten years ago.

The writer of your leader has not, I think, closely gone into the question of the economics of power production at combined stations, otherwise he would never have penned the words in the last paragraph. The effect of calculating the tramway rates with reference to the annual charges on the whole capital expenditure of an undertaking in which bulk supplies of power form a large percentage, is favourable indeed to the tramways departments, so much so that we have in Manchester agreed upon a rate for the next three years which shall be calculated on that part of the undertaking which directly concerns the tramway power supply. It is here where the tramway departments who take their supply from combined stations have the pull, they may reasonably expect the prices paid for their energy to fall, due to the influence which the large power supplies have on the capital charges incidental to the combined undertaking. But in the case of separate tramway stations working on a more or less fully developed system, the power costs are only influenced by economies in running expenses—the capital charges will remain practically constant.

S. L. Pearce.

Manchester Corporation Electricity Works,
September 14th, 1909.

[Mr. Pearce omits to mention that the £136,145, power expenses at Glasgow in 1908, included £47,547 for depreciation; deducting this—as it has no counterpart at Manchester—we have £88,600 net power cost, which, spread over 25,200,000 units, issued from sub-stations, *used in car works, depots, &c*, gives a total cost of ·84d. per unit, as compared with 1·14d.—say 1d. per unit, if we allow a proportion for renewals in the Manchester figure for 1908. As regards the advantage of linking up, the Glasgow tramways department only purchased 13,557 units from the lighting department in 1909. If so much benefit is derived at Manchester—which is in a distinctly superior position to the majority of towns—from the influence of the large power supplies on the capital charges as a whole, how is it that the Manchester tramway charges so much exceed those of Glasgow, and are, in fact, calculated directly on the plant used for tramway supply?—EDS. E.R.]

Ignition Magnetos.

As a reader of your valuable paper I should like you to enlighten me as to the reason why no British firm can manufacture a magneto machine that will approach any of the foreign makes in efficiency. I have been assured that it is so. Surely it is not that we have not the ability. Various motor-car builders state that they cannot obtain a satisfactory magneto, no matter what price is paid for them. It is very humiliating to be told that we have not the brains in England.

Harry Owen.

Widnes, *September 13th*, 1909.

Packing for Shipment.

In a recent issue of your journal you referred to the rough usage to which cases of machinery, &c., are subjected in foreign parts, and the consequent need for the most careful packing. In this connection, the enclosed

photograph, which shows cases containing electrical machinery, switchboard panels, &c., just deposited on the quay, at a port which shall be nameless, may be of interest. Incidentally, it confirms your remarks as to the uselessness of "This side up" and similar labels.

T.

Curious Lamp Failure.

Replying to "N. B.'s" letter and photograph of a glow lamp failure. Although he states, on breaking the lamp, the filament was intact, he omits to say whether the lamp in the ordinary term was burnt out, *i.e.*, would not light when applied to the current. Was it devoid of vacuum? If it had been examined for this, in all probability it would have been found to be the case, also minus vacuum, and still the filament intact. The dinting of the bulb is easily explained. It is caused by burning lamps in confined spaces, so that when it is alight the temperature rises enough to bring the thin glass of the bulb to a soft state, allowing the atmospheric pressure to dint the glass, as in the photograph. If the lamp had been minutely examined it would have been seen that the glass of the bulb had touched the filament,

which, being incandescent, quickly burns a hole in the glass, then away goes the vacuum, which accounts for the deposit of soot. The excessive current caused to flow, through the loss of the vacuum, being enough to fuse the connection of the lamp to the bayonet top before the filament burnt through.

I have had many instances of the denting phenomenon of lamp bulbs. Ordinary 50-C.P. carbon-filament glow lamps employed for street lighting purposes, which were enclosed in 7-in. spherical globes, after burning a month or so used to become hot enough to allow the atmospheric pressure to press in the glass bulb until it touched the filament, which immediately burnt a hole, as I have already stated; so it is quite feasible for this to have happened to a lamp burning in the vicinity of an engine, where the temperature of the atmosphere is considerably higher than in the open air.

Another peculiar phenomenon that has come under my notice, which I should like to see explained, is:—Osram lamps burnt in the same kind of globes, the neck of which just allows them to pass in, on burning out cannot be extracted from the globe without first breaking either the globe or the lamp, the bulb of the lamp having apparently swelled. I have seen four separate instances of this.

H. R. G. F.

Carbon Brushes.

A very large number of your readers must be interested in, and have considerable experience of, the behaviour of carbon brushes on dynamos and motors, and yet they remain a puzzling problem to those whose business it is to satisfy the caprices of the machines on which the brushes have to work. Every maker could, I think, quote instances both of conspicuous successes and of abject failures with identically similar brushes on different types of machines of equal merit as far as regards design.

There can be little doubt that an ideal brush should collect sparklessly with the lightest possible pressure at all loads, for this must result in a minimum of wear and tear of both commutator and brush.

An instance has recently come to my notice where a set of four brushes were put upon a 25-H.P. motor driving a shop averaging about seven hours' work a day.

Preliminary tests of friction gave definite indications of the difference of pressure necessary to collect at full load compared with those brushes previously used, but the results were even more remarkable. The brushes were taken out after rather more than five years' regular work, and were found to have worn down just 10 mm., or 2 mm. per year. The old type of brush used to last from seven to eight months. At the same rate of wear the new brushes would have a life of from 10 to 15 years!

It would be interesting to know if similar instances can be quoted by any of your readers. The armature had never been out of the machine during the five years, and the brushes were only taken out in order to make further comparative tests.

The vagaries of carbon brushes must be an interesting study to those who have to look after them, and, perhaps, some of your readers can from their experience throw some interesting light on the subject.

W. Stepney Rawson.

London, W., *September 14th*, 1909.

PROCEEDINGS OF INSTITUTIONS.

Hydro-Electric Power in Canada.

By Cecil B. Smith, M.Am.Soc.C.E.

(*Abstract of paper read before the* American Society of Civil Engineers, *September 1st*, 1909.)

The population of Canada is familiarly spoken of as agricultural in character, but this is only relatively true, as large and important industries flourish throughout the Eastern Provinces, and even in this young and sparsely-populated country the increase in population is almost entirely urban in character, except on the great wheat plains of the Middle West.

Coal is available on the extreme west and east, but for 2,000 miles, covering much of the most populous and fertile centre of the country, it is necessary to import coal from the United States for heat and power. From a hydraulic point of view, however, the country has been peculiarly favoured, as a glance at the map will show.

The Hudson Sea is deep set into the heart of the country, and the height of land between the waters flowing to this sea and to the St. Lawrence drainage system is from 1,200 to 1,500 miles long, and, what is of more importance, it is only from 1,000 to 2,000 ft. above the sea, and is not of a mountainous character, but is a perfect network of lakes, swamps, rock, and forest, and affords a good reservoir and regulator for hundreds of large rivers, which, as they reach the parent St. Lawrence, descend over precipitous Laurentian rapids, admirable as sources of hydraulic power. This condition obtains all over Canada as far west as Eastern Manitoba, and, as the rainfall averages from 25 to 40 in. per year, with no marked tendency to drought, and as the long winters store up so much moisture that the low-water period often merges into the period of autumn rains, the pinch of low water is not in many cases a serious menace, except in the March of severe winters. On the great western plains the topography and climate both militate against hydraulic values.

Until 20 years ago, hydraulic power often formed the basis of growing industries and determined frequently the location of the centres of population, but the larger centres of trade were developed by rail and water transportation and in many cases were quite distant from such sources of power.

With the advent of electric power transmission, however, these cities offered a favourable market for the sale of light and power from distant sources, and private companies, and in some cases municipalities, have invested large sums in hydro-electric constructions and transmission systems to serve the adjoining districts.

On the Atlantic seaboard, in the presence of extensive coal measures and coal mining, the incentive to hydro-electric development has been lacking; indeed, a recent installation of steam-electric equipment having a capacity of 500 KW. at the pit mouth, from which electric energy is transmitted at 11,000 volts to Amherst, N.S. (distant 6·5 miles), may be but the pioneer of much more extensive installations of a similar character in other parts of America.

Farther westward in New Brunswick, there exists the condition more usual in Canada, namely, rivers having large drainage areas, and having their sources in swamp, forest, lake and muskeg, in which snow and frost linger late in April, or even until May, and feed these rivers throughout the dry months of August and September; indeed, it is usual in Canada to find the extreme low-water period in March, before the frost has ceased to hold the moisture from flowing. The Miramichi, Restigouche and St. John are great rivers, and extensive hydraulic constructions may be expected for grinding pulp alone, in addition to serving near-by towns and cities by transmitted electricity.

A most interesting and extensive development has been commenced at Grand Falls, N.B., by the Grand Falls Power Co., where the St. John River, with its sources in hundreds of lakes of Northern Maine, falls abruptly 115 ft. over a slate barrier.

For these hydro-electric works the type of construction which has been selected is that of vertical 10,000-H.P. three-phase 25-cycle 11,000-volt units, operating under a head of 130 ft., and the designs, under which contracts for the construction of the works are about to be let, provide for a hydraulic capacity of 80,000 H.P., with a present machinery installation of 40,000 H.P., which will generate current for ferro-manganese smelting, pulp grinding, and for transmission to the cities of Woodstock (70 miles), Fredericton (125 miles), and St. John (165 miles). An interesting feature of the design is that the generators are to be placed in the wheel pit immediately above the turbines, with a provision for the proper ventilation of this subterranean chamber, as well as careful water-proofing to ensure satisfactory electrical conditions. The tunnel tail-race will be placed entirely below the level of the tail-race water, and the draft tubes from each unit, therefore, will be brought into the top of the tunnel from one side of the wheel pit; this, it will be noted, is a variant on the methods adopted by the Toronto and Niagara Power Co. in its works at Niagara Falls, Ont.

On the Pacific Coast, the hydraulic conditions are very different from those in other parts of Canada, for the great mountain ranges are not good reservoirs, and, although the glaciers feed the rivers until late in the summer, yet at other seasons, owing to the light rainfalls east of the coast range, the rivers become very much reduced in volume; thus the excessive floods of the Fraser River, for instance, make it unsuitable for hydraulic development for power purposes. Near the coast, however, the rainfall is excessive, and the existence of small lakes has facilitated the construction of several interesting developments, serving Vancouver and the adjoining territory.

The works of the Stave Lake Power Co., now under construction, are 35 miles east of Vancouver, on Stave River, where a head of 90 ft. is to be utilised. The equipment will consist of five units, each of 5,000 H.P., and it is considered that the electrical output from this installation has a good prospective market in Vancouver and Westminster, to which the current is to be transmitted at an ultimate voltage of 60,000.

The Vancouver Power Co., Ltd., has a most interesting development at Butzin Lake, 18 miles from Vancouver. This has been made possible by diverting the water of Coquitlam River at Lake Coquitlam into Butzin Lake by a 2½-mile tunnel having a section of 73 sq. ft. At Butzin Lake the water is taken from the head works by steel pipes to a power house, 1,800 ft. distant, and located at sea level, 400 ft. lower.

The generating equipment is typical of the Pacific Coast, being originally composed of four units, each of 3,000 H.P.; two Pelton

wheels for each unit drive a 3,000-H.P. 2,300-volt generator at 200 R.P.M., in addition to which there is also a recent installation of a 10,000-H.P. generator driven by four Pelton wheels, thus making an equipment having a total generating capacity of 22,000 H.P.

The electric current from this station is stepped up to 23,000 volts and transmitted to Vancouver, New Westminster, Burnaby, Lulu Island and elsewhere, and is used for operating electric railways, salmon canneries, car shops, saw-mills, and for general municipal and industrial purposes, thus serving the requirements of an urban population of about 90,000.

The transmission line consists of double towers each carrying two circuits of three-phase, No. 2, B. & S., copper cable, and crosses navigable water at one place, where there is a span of 2,750 ft. suspended 150 ft above the water.

The total single three-phase circuit length of lines is 135 miles, and the transformer capacity at present in service is 14,650 KW. at the generating station and 16,400 KW. at the various sub-stations; all these transformers are air-cooled, and are of different sizes up to a maximum of 2,500 KW. per phase.

The only interesting hydro-electric plant is that of the West Kootenay Power Co., built to serve the mines and smelters at Rossland, Trail, and in the boundary district. It is located at Bonnington Falls, on the Kootenay River, 9 miles west of Nelson, B.C.

The hydraulic head varies from 65 to 55 ft., being least at high water, and the minimum capacity of the river is estimated at about 6,000 cb. ft. per sec., being the run-off from a mountainous drainage area of nearly 10,000 sq. miles, which owing to the glacial sources of the river, gives a low-water period in winter and a high water period in summer. The station is a very interesting example of complete concrete construction, including even the intake channels and draft-tubes of the turbines, and is constructed for an equipment of four units, each of 6,000 H.P., nominal rating, with the turbines of 30 per cent. overload capacity. At present, two units are installed and a third has been ordered, in addition to which the whole station has an equipment of 2,700 KW., and, when required, serves Rossland and Trail over a 31-mile, cedar-pole line at 20,000 volts on two No. 0 B. and S. three-phase circuits.

The step up transforming station supplies 60,000-volt current for the new cedar-pole transmission circuits to Phoenix Mines and Grand Forks Smelters, and to Greenwood Mines, distant 79, 69 and 83 miles respectively; and its present equipment consists of six single-phase water-cooled transformers, each of 1,850 KW. nominal rating, each three-phase bank being in a fire-proof compartment; there is also a bank of three single-phase 1,250-KW. transformers held in reserve for the Rossland and Trail Districts at 20,000 volts in the event of a shutdown of the older station. The total transforming capacity in seven sub-stations is 31,000 KW., and the active connected load is 21,000 H.P.

The adjoining zinc and lead smelters at Nelson, B.C., will be supplied by these works or by the municipal hydro-electric works of the city of Nelson, on the other side of the river from the large power station just described. This municipal power station has an equipment of 1,000 H.P., which is about to be increased to 2,500 H.P. by the installation of a second vertical unit.

The Saskatchewan River, of 125,000 sq. miles drainage area, rising in the eastern slope of the Rocky Mountains by many sources, fed from glaciers, and descending to the plains through many mountain gorges, offers, near its sources, reasonable opportunities for hydraulic development.

At a point on this river immediately before it enters Lake Winnipeg, at Grand Rapids, the change in level is 112 ft. in a few miles, and there is thus afforded the opportunity for a development of at least 300,000 H.P. whenever the demand arises for a power development at that point.

The Winnipeg branch of the Nelson River drains an area of approximately 55,000 sq. miles in the State of Minnesota and in the Provinces of Ontario and Manitoba, and, from its peculiar topographical features, affords one of the most favourable locations for the development of hydraulic power in Canada, excelled, perhaps, only by the Niagara and the St. Lawrence, and superior in some respects to the Ottawa River.

The more extensive water-power locations of this river are rated by the Hydro-Electric Power Commission of Ontario at a total of 100,000 H.P., minimum dry-weather flow, 24-hour service, and it may be considered that the commercial capacity is at least 200,000 H.P., under ordinary conditions. It seems evident that the requirements of railway operation, flour milling, pulp and paper mill work, and possibly smelting will demand a careful study of the specific value of these powers in the near future, as soon as the trans-Continental railway is in operation. The Koochiching Falls, at Fort Frances, is being developed on a basis of 14,000 H.P., for which the dam construction is now completed and power construction is under way.

The Winnipeg River proper commences at Kenora, where the river leaves the Lake of the Woods, and from this point to the mouth of the river there is a chain of falls and chutes which, as sources of economical power it is difficult to surpass or equal. The two conditions worthy of comment are that at each power location the rocky barrier creating the fall is admirable as a foundation for a dam, thus enabling constructions to be low in first cost, and at the same time creating considerable local storage to meet daily peak-load requirements. Also, the enormous lake storages very much reduce the flood discharge and increase the minimum.

Table I is a summary of the power sites on the Winnipeg River proper, between Kenora and the mouth at Fort Alexander.

Of the sites mentioned in Table I, Island Falls, Point du Bois, Slave Falls, Upper Seven Portages, and Grand Bonnet afford excellent construction opportunities. All but the first two in Table I are within easy transmission distance of the City of Winnipeg, and all are within short distances of two trans Continental railway systems.

TABLE I.—Power Sites on the Winnipeg River.

Location.	Available head, in feet.	Minimum electric horse-power; 24-hour rating.	Average electric horse-power; 24-hour rating.	Remarks.
Kenora	18	21,000	42,000	5,500 H.P. installed
Island Falls	45	56,400	112,800	
Point du Bois ...	46*	83,600	209,000	20,000 H.P. being installed
Slave Falls	30*	54,500	136,200	
Upper Seven Portages	30*	54,500	136,200	18,700 H.P. installed at Lee Channel
Lower Seven Portages	22	40,000	100,000	
McArthurs Falls ...	12	22,300	55,750	
Grand Bonnet ...	30	56,000	140,000	
Little Bonnet ...	10	18,500	46,200	
White Mud Falls ...	15	28,000	70,000	
Silver Falls	21	39,100	97,800	
Pine Portage Falls ...	12½	23,300	58,300	
Totals... ...	—	497,200	1,204,250	

* Including raising the water level by head works.

The situation at Kenora illustrates the great value of water-power as applied to flour-milling. The town has little else to recommend it as an industrial centre, not being at a competing railway point, nor at a bulk-breaking point; neither is there any surrounding population or any fertile areas; but, in spite of these apparently unfavourable conditions, three large flour mills are located there, and use about 4,000 H.P., with a capacity of 10,000 bbl. per day. Two of these plants operate privately-owned hydraulic equipments, and the third purchases 1,000 E.H.P. at a flat rate of $10 per E.H.P.-year, from the municipal power station. The latter has been built recently at the eastern outlet of the Lake of the Woods, with dimensions to receive machinery having a capacity of 4,000 E.H.P., one-half of which has already been installed.

At the main or western outlet of the Lake of the Woods, at Kenora, there has also been built for some years, a stone dam from which water could be drawn to develop approximately 18,000 E.H.P. at low water, but no further constructions have been commenced.

At Point du Bois the city of Winnipeg (population 120,000) has commenced the construction of a large generating station involving a 75-mile transmission line to the city, and the designs contain some interesting features. A short (1,200 ft.) head canal, concrete overflow walls, and a rock-filled dam in the main river will raise the water 13 ft., creating a total head of 46 ft. and forming a lake 5 sq. miles in area, thus producing uniform and quiet hydraulic conditions. The dimensions of all control works, dams, &c., provide for an ultimate equipment of 60,000 H.P. The remainder of the work is to be a solid reinforced concrete structure involving an enclosed forebay room, power house, and transformer station equipped primarily with five 5,300-E.H.P. units, which will consist of horizontal, double-runner turbines (draft chests only) in reinforced concrete wheel-pits and directly connected through a breast wall to three-phase, 60-cycle, 6,600-volt generators making 164 R.P.M.

The transformation will be to 77,000 volts, by water-cooled, oil-insulated transformers having a capacity of 3,750 KW. per phase. Similar transformation at Winnipeg will be from 72,000 volts down to 11,000 volts in a main terminal station, from which 11,000-volt feeders will distribute to three or more sub-stations for local distribution at suitable voltages; the transformers at the terminal station, however, are to be oil-circulating, and oil-cooled. The system of remote control will be fully applied at both stations.

The transmission lines, of No. 000 copper, or aluminium equivalent, will be carried on double-circuit steel towers spaced 600 ft. apart, each alternate tower being of elastic type, with two legs only. All tower foundations are to be on concrete.

The city utilities are already numerous, and include artesian water supply, pumped electrically; and the desire to be able to offer cheap power to industries, present and prospective, which would otherwise labour under a great disadvantage in a city which cannot offer bituminous coal of a good quality for less than $6·50 per ton, while anthracite coal is $10·50 per ton retail, appears to be ample justification for this ambitious project for a city of 120,000 inhabitants.

(To be continued.)

Magnetic Clutches.—Messrs. C. E. Lugard & Co., of Middlesbrough, have received an order for an electromagnetic clutch to transmit 1,000 H.P. at 75 R.P.M. This clutch will weigh about 7 tons, and is believed to be the largest in the world. Electromagnetic clutches transmitting 1,200 H.P. at 350 R.P.M., 800 H.P. at 215 R.P.M. and 600 H.P. at 375 R.P.M. have been installed on the Continent for driving wire rod or small section mills.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The "Vickers" One-Lock Adjustable Reamer.

To meet the demand imposed by modern methods for a satisfactory adjustable reamer for accurate work, Messrs. Vickers, Sons and Maxim, Ltd., of 32, Victoria Street, S.W., have introduced the neat device illustrated in fig. 1. In this reamer the shell is made in one piece, with a parallel or Morse taper shank, and is bored and slotted to receive the cam bolt and blades. Fig. 2 shows the end view with these parts in position, and it will be seen that the blades can be gradually forced outwards by rotating the cam bolt, the surface of which is formed somewhat like a ratchet. A

Fig. 1.—"Vickers" One-Lock Adjustable Reamer.

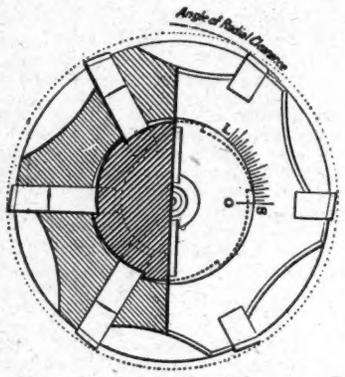


Fig. 2.—Front Elevation and Section of Reamer.

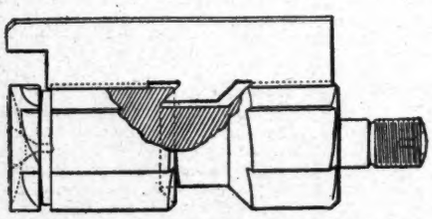


Fig. 3.—Mode of Securing Blades to Bolt.

scale and gauge point on the end of the shell and bolt provide means for preserving the setting. The side view, fig. 3, shows how the blades are locked into close contact with the cam bolt. All the blades are adjusted simultaneously, and the cutting edges are backed off to give radial clearance. A nut on the end of the cam bolt serves to lock the blades after adjustment; this nut lies in a recess in the shell, and cannot be accidentally disturbed. The front end of the reamer is free from obstructions, so that a blind hole can be reamed to the bottom. The parts are, of course, interchangeable, and the reamers are made in sizes from $\frac{3}{4}$ in. to $6\frac{3}{16}$ in. in diameter, the smallest having 6 blades and the largest 14 blades.

Telephone Recorder.

The accompanying illustration, fig. 4, represents a neat and handy instrument which is being put on the market by the Telephone Recorder Co., of 11, Adam Street, Strand, W.C. It is made to stand on a table or to be fixed on a wall, and carries two rolls of paper—one to tear off at the right-hand edge, with the message duplicated on it, and the other to be rolled up inside, bearing the original written record of the message received. The carbon paper used for obtaining the duplicate is always in position, and the filed record is easily referred to when necessary. With

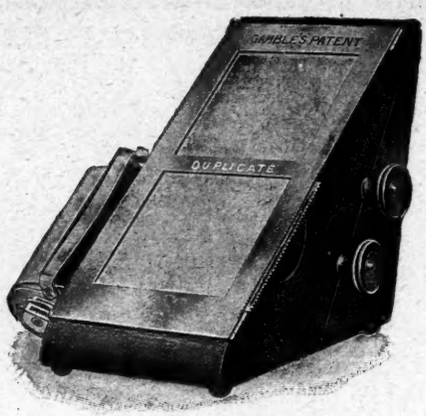


Fig. 4.—Telephone Recorder.

one of these recorders at hand, the usual hunt for a scrap of paper to take down a message, and the ensuing hunt for the memorandum next day, will become things of the past.

"Aron" Maximum-Demand Indicator.

The Aron Electricity Meter, Ltd., of 80A, Salusbury Road, Kilburn, have devised a simple attachment to their clock meter for the purpose of recording the maximum demand over a predetermined period. As shown in fig. 5, a pin *a* is fixed on the arbor of the pointer, which indicates the maximum demand on a dial. An arm *b*, which engages the pin, is attached to the indicator wheel *g*, which is controlled by a hair spring. At suitable intervals—

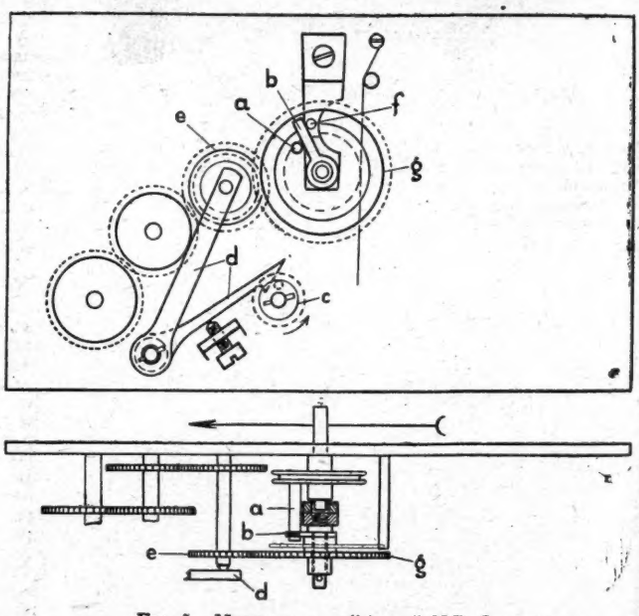


Fig. 5.—Mechanism of "Aron" M.D. Indicator.

generally 20 minutes—the change-over gear of the Aron meter, connected to wheel *c*, lifts the double lever *d*, and thus disengages the wheel *e*, which is driven by the counting train, from the indicator wheel *g*; the latter therefore is carried back by the spring to its original position against the stop *f*, leaving the pointer behind on the dial. After a few seconds the lever *d* drops again, bringing the wheel *e* once more into gear with wheel *g*, and restarting the indicator. The principle of the device is based on the fact that the change-over gear acts at regular intervals, and the number of revolutions of the counting train during each of these intervals is exactly proportional to the consumption during that time; thus the indicator records the energy used during a given short period, or the average demand during that period, and the pointer only moves when that value exceeds the maximum previously attained. The size of the meter is not increased; the action is purely mechanical, and the accuracy is equal to that of the meter itself. The device is applicable to all systems of electrical circuits, D.C. and A.C., and is easily reset.

Economical Turn-down Lamps.

Messrs. Geipel & Co., of St. Thomas Street, S.E., who have been supplying turn-down lamps for a considerable time, have sent us particulars of their latest types. The "Pull-String" type has two filaments, one an ordinary 8 or 16 C.P., the other a 1-C.P. filament. The switch is contained in the lamp cap for switching one or the other filament into circuit.

These are supplied in all voltages from 50 to 250, and of either 8 and 1 or 16 and 1 c.p. The 8 and 16-c.p. filaments take 4 watts per c.p., and the 1-c.p. filament takes 8 watts for the 1 c.p.

The "Hylo" long cord type, which is here illustrated, is a new lamp which Messrs. Geipel are supplying, with cords 3, 6, 10 and 15 ft. long. The switch has a rotary action with a flexible chain.

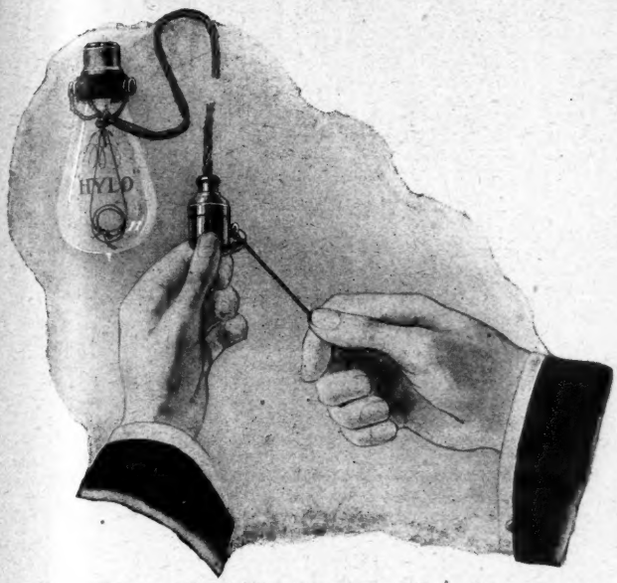


Fig. 6.—"Hylo" Long Cord Turn-Down Lamp.

The first pull turns the lamp on to its full power (8 or 16 c.p.), the next pull reduces it to 1 c.p., the third pull turns the light out. This action can then be repeated. Messrs. Geipel supply to dealers, for showroom purposes, a machine worked by electricity, with hands which pull the string, constantly changing the light from high to low and from low to high.

BUSINESS NOTES.

Book Notices.—*Annuaire International de l'Acetylène.* By R. Granjon and P. Rosemberg. 1909. Paris: Office of *l'Acetylène.* Price 2 fr. 50.—In addition to a mass of general information regarding carbide of calcium and acetylene, and apparatus used in conjunction therewith, this annual, now in its second year, gives a quantity of statistics relating to the manufacture and uses of these substances. It appears that there are 74 carbide works in existence, of which this country possesses no more than two; it happens that the United States has the same number, but the latter aggregate 40,000 h.p. to our 3,100 h.p. Thornhill, in Yorkshire, and Collooney, in Ireland, are the sites of the British plants. Our annual consumption is 12,000 tons, of which we import five-sixths; Germany consumes 40,000 tons, a far greater amount than any other country, necessitating the importation of 30,000 tons. Other European countries produce more than they require for their own use, particularly Norway and Sweden, which together export 45,000 tons. The total output of the world is put at 240,400 tons, with plant of 333,800 h.p. The "towns"—most of them really villages of one to two thousand inhabitants—lighted with acetylene are said to number at least 836, probably more like 1,000; 16 of these are British.

The Aero Manual. London: Temple Press. Price 1s. 6d. net.—This handbook has been compiled by the staff of "The Motor," and gives a concise review of the history, principles and practice of mechanically propelled human flight, with numerous illustrations. It is unfortunately true that up to the present electricity has played only an insignificant part in the development of this art, and until a new battery, primary or secondary, is devised, representing a very great advance over those at present available, there is no great likelihood of its becoming more extensively employed in the air. But progress in this branch of engineering has been extraordinarily rapid since the petrol motor was evolved, and if, as enthusiasts declare, aerial locomotion becomes a popular means of transport, it is quite conceivable that the trans-Atlantic liner of the future will be equipped with turbo-generators and motor-driven propellers. In any event, the subject is one of absorbing interest, and we have found this admirable book to be full of information on human flight, gliders, aeroplanes, dirigibles, aerial motors, and details of design. We can strongly recommend its perusal to engineers, and can promise them that, unless they are already familiar with the subject, they will learn some facts with regard to the behaviour of planes moving in air which will surprise them.

"*Journal* of the I.E.E.," Vol. 43, No. 196.—The part recently issued contains the following papers:—"The Use of Large Gas Engines for Generating Electric Power," by L. Andrews and R. Porter; "The Dielectric Strength of Compressed Air," by E. A. Watson; "The Kapp-Hopkinson Test on a Single Direct-Current Machine," by Dr. W. Lulofs; "Fly-wheel Load Equalisers," by J. S. Peck; "Notes on Safety of Working Electrical Plants in Coal-mines," by S. A. Simon; and an original communication on "The Dimensions of Transformers," by A. R. Low.

"*Transactions* of the Institution of Civil Engineers of Ireland." Session 1908-9. Dublin: John Falconer. 1909.

The *Faraday House Journal* for September contains an interesting account of the career of the late Principal, Mr. Hugh Erat Harrison, and of that of his successor, Dr. Alexander Russell, each accompanied by a portrait of the subject of the article.

"*Proceedings* of the Engineers' Club of Philadelphia." Vol. XXVI, No. 2. April, 1909. From the Club.

"Syllabuses Applicable to Technical Schools, &c., in England and Wales." Issued by the Board of Education. London: Wyman and Sons. Price 4d.

"*Journal* of the American Society of Mechanical Engineers," September, 1909. Vol. XXXI, No. 7. Baltimore, Md.: From the Society.

"Continuous-Current Dynamos and Motors." By W. R. Kelsey. Second Edition. London: Technical Publishing Co., Ltd. 1909. Price 7s. 6d.

A new edition of "The Dynamo: Its Theory, Design and Manufacture," by C. C. Hawkins and F. Wallis, will be published immediately by Whittaker & Co., this well-known work having been thoroughly revised and considerably enlarged.

Gold Mirrors for Searchlight Projectors.—We have on previous occasions mentioned Mr. Cowper-Coles's invention of glass mirrors coated with gold instead of the usual silver deposit; the resulting beam of light is composed of red, yellow and green rays only. At the same time its range or penetrative power is not reduced, and by the elimination of the violet rays, the dazzling effect is greatly diminished. It is interesting to note that in the recent R.A.C. tests the only three motor-car lamps fitted with gold reflectors secured the first three places for maximum distance from lamp without dazzle. For naval projector work it is found that a torpedo-boat on a foggy or rainy night can be more clearly seen with a gold than with a silver mirror projector; the objects illuminated stand out more prominently and there is truer colour rendering. The gold mirrors are supplied by the Reflector Syndicate, Ltd., of 82, Victoria Street, Westminster, S.W., who hold the patents for the process.

Meldrum Destructor Results.—We have received a detailed statement of the daily consumption of output of the refuse destructor supplied to the Prahran Municipality, Victoria, by Messrs. Meldrum Bros., Ltd. During the month of July the refuse burnt amounted to a weight of 661 tons 2 cwt., and the electricity generated to 27,870 units; the units generated per ton of refuse (average) were 42·6, and the revenue for the month, at ½d. per unit, was £58 1s. 3d.

Consular Notes.—Poland.—The British Consul at Warsaw reports that telephonic communication in that town is growing rapidly in favour. The number of subscribers has risen from 2,372 in 1901 to 14,817 in 1908. The service is open day and night. The subscription at present stands at £7 5s. 4d. per annum for business houses and £6 6s. 8d. for private residences, with an unlimited number of calls. Warsaw is now connected by telephone, through Lodz, with Kalisz, on the German frontier, but at present through connection with Germany has been prevented by the action of the censor. The line from Lodz to Kalisz runs through Lask, Zdunska-Wola and Sieradz, and is 68 miles in length. It was constructed by private enterprise at a cost of £45,000. From Lodz to Warsaw the line is Government property. Three minutes' conversation between Warsaw and Kalisz costs 2s. 6d. The Lodz-Warsaw and Lodz-Kalisz rates are 1s. 6d. and 1s. respectively. Thanks to the severe measures adopted by the Governor of Lodz, the former interruptions of communication, caused by the thefts of wire by the inhabitants of the suburbs of that town, has been stopped. A line between Warsaw and Lublin is practically completed. A plan, supported by those merchants who desire to develop trade with Austria-Hungary, has been proposed by the Director of Posts and Telegraphs at Lemberg, for constructing a line between Warsaw and Cracow. If this plan should be carried out, Warsaw will be in direct communication with Vienna. At the usual telephone rates, three minutes' conversation between the two towns will cost about 2s. 10d. As stated in the report for the year 1907, the opening of the electric tramways of Warsaw was postponed until 1908. Operations were started in March, and at the close of the year 15 of the 22 completed lines were in use. The number of cars is 200. The system is the overhead wire and the service has been good. The cars are of the central corridor class and give seating accommodation to 24 people on cross benches. On both the front and the rear platform eight persons are allowed to stand. The fares for 2 versts, *i.e.*, 1·326 miles, are first-class, 1¾d., second class 1¼d. The system, which is a municipal undertaking, was built by a Belgian company, electrified by a German firm, and let for operation and management to a Polish syndicate. The cars are well patronised, and are stated to be making £2 per car per day more than was anticipated. Since the introduction of the tramways the number of horse cabs has diminished by 50 per cent. Though there are plans for extending the tramways in the town to various neighbouring villages, there is not much prospect of the proposal being carried

out. The so-called first and second class streets in Warsaw are now lighted by electricity. The suburb of Mokotow has built its own station, which supplies 150 lamps of 50 C.P. each to the adjacent streets. Private orders for electric light installation have been so numerous that a new set of plant is required for this suburb. Lodz is installing the electric light. The towns of Zgierz and Ozorkow are also completing similar works.

Later in his report the Consul states that the ill-feeling created by the action of the German Government in passing the Polish Expropriation Bills has excited the whole Polish population against Germany and anything German, and has opened the door to British goods of every description. There is an opportunity now for British manufacturers and merchants to break the monopoly of trade which has hitherto been enjoyed by their German competitors. [This new position was fully discussed in the ELECTRICAL REVIEW last year—August 28th, 1908.] It is no exaggeration to say that there is no branch of commerce for which a good opening does not exist. A successful venture, however, depends on a study of the local requirements and conditions, and an endeavour to establish a reciprocal trade, without the intervention of the German middleman, who at present is in supreme control. Attention should especially be paid to the Jewish section of the mercantile community, as 80 per cent. of the total trade passes through their control. This is a survival from the times when no Pole would engage in trade; but, even in spite of the large increase of Jews, owing to the emigration from other portions of the empire, the Pole is gradually asserting himself and emancipating himself from the necessity of Jewish assistance in his business. Endeavours are being made in Warsaw to form a local section of the Russo-British Chamber of Commerce at St. Petersburg, but at present nothing is definitely settled. It would be useful if British merchants, who already have established agencies in the district, would communicate the name of their agent to the Consulate at Warsaw, as often, from want of knowledge as to where British articles can be obtained on the spot, local merchants cross the frontier and obtain the same thing of German make. A few of the catalogues received at the Consulate have French or German translations. German is generally understood by all business houses, but a Russian text would be useful in the district now being dealt with, and also throughout Russia.

Note for Shippers to Mexico.—Shippers to Mexico will be interested to learn that the disability of not being able to consign on through bill of lading to interior points in the Republic has been removed, and these documents can now be obtained from all the steamship companies serving Mexican ports. Information regarding this and other matters relating to Mexico will be gladly given on application to Mr. E. J. Bray, the General European Agent of the National Railways of Mexico, at Dashwood House, 9, New Broad Street, London, E.C. This office has been specially inaugurated by the Government lines to protect their interests in Europe, and with the further object of putting at the disposal of shippers, and all who are interested in Mexico, information concerning the country.

Impulse Turbines.—We are informed that MESSRS. WILLANS & ROBINSON, LTD., after prolonged experiments, are placing on the market a steam turbine of the Impulse type, intended to meet those cases in which a speed of as high as 3,000 R.P.M. is admissible. This will provide for a capacity up to 1,500 KW. The turbine has been designed with a view to efficiency, as well as simplicity. The rotating element consists of two wheels only, but, it is stated, the economy realised compares favourably with that of any other turbine. In future, therefore, Messrs. Willans & Robinson, Ltd., will be in a position to supply turbines either of the Parsons or of the Impulse type, and they are prepared to put forward the type most suitable for the conditions to be met.

Bankruptcy Proceedings.—HERBERT JOHN BURDETT, electrical engineer and contractor, 16, Regent Street, Rugby, and 32, Earl Street, Coventry.—The summary of debtor's statement of affairs issued by the Official Receiver (Mr. C. J. Band, Coventry) shows gross liabilities £1,214, of which £1,154 is expected to rank for dividend. The assets are estimated to produce £363, against which there are preferential creditors for £28, leaving £334, and a deficiency of £819. The causes of failure, as alleged by debtor, are "trade depression in Rugby, competition, bad debts, illness and heavy rental." From the Official Receiver's observations, it appears that debtor commenced business with a capital of £150 in February, 1902. The principal electrical trade creditors are :—

General Electric Co.	£64	Simplex Conduits Co.	£18
Marsh, Son & Co.	33	Callender's Cable and Construction Co.	13
Robinson & Hands	30	Enterprise Electric Co.	12
British Thomson-Houston Co.	28	Edison & Swan United	11
Electrical Co.	26	Falk, Stadelmann & Co.	11
G. Braulik	23	Electrical Trades Supply	10
Siemens Bros. Dynamo Works	21		
Hawkins & Co.	19		

The first meeting is to be held on September 20th, and the public examination on October 11th.

J. W. SYDENHAM.—The public examination was held on Tuesday before Mr. Registrar Giffard, at the London Bankruptcy Court, of John William Sydenham, sales manager, 65, Connaught Street, Marble Arch, who failed in July with liabilities £366 and assets nil. In the course of his evidence, the debtor stated that for the past eight years he had been employed in the electrical engineering trade on the commercial side, latterly at a salary of £200 per annum. In April, 1908, with £20 capital, he commenced to speculate for differences on the Edinburgh Stock Exchange, mostly in home and American rails, and although he won at first, he eventually made a loss of £395. On June 10th last judgment for £241 was obtained against him, and being unable to satisfy it, he was made bankrupt. Witness attributed his failure and insolvency entirely to those losses. The examination was concluded.

P. E. BUTLER.—The first meeting of creditors was held on Tuesday before Mr. W. P. Bowyer, Assistant Official Receiver, at the London Bankruptcy Court, under the failure of P. E. Butler, described as late of 8, Hill Street, Knightsbridge. The debtor, who returns liabilities £1,471, against assets £7 10s., states that, since 1899, he has had no occupation beyond acting as director of various companies, in which he invested and lost between £25,000 and £30,000. In 1903 he financed the Electric Light Renovating Co., Ltd., to the extent of between £8,000 and £9,000, of which about £5,000 or £6,000 was his own money. In or about 1906 the debenture-holders foreclosed and sold the whole of the company's property. The debtor had made himself liable for the lease of the works in Britannia Street, Shoreditch, and the landlord obtained judgment against him in respect of an outstanding balance of £250. The failure was attributed by the debtor to losses in connection with the various companies he had financed. He made no proposal and the creditors left the estate in the hands of the Official Receiver to be wound up in the ordinary course of bankruptcy, the debtor's public examination being fixed for October 27th.

HERBERT SHUTTLEWORTH, Cross Court, Briggate, Leeds, electrical engineer.—The debtor appeared for his public examination at Leeds on the 14th inst. He said he resided with his parents and was unmarried. He had carried on business as an electrical engineer at the above address since February, 1906, having had nine years' previous experience of the business. He had no capital, borrowing £20 from his father, afterwards obtaining other loans from him. The amount now owing to his father was £357, including £197 amount of bank overdraft guaranteed by him. His total liabilities, according to his statement of affairs, were £465, and he estimated that his assets, including £50 good book debts, would realise £74 11s., leaving a deficiency of £391. He alleged his insolvency to be due to bad trade and competition. He had principally done wiring, and prices were cut very much in that line. His net profit, shown by his deficiency account, was only £25 19s. 7d. since February 1st, 1906, but he found, on making up his cash-book, that the amount should be £114. At the same time, he admitted that his living and personal expenses during the same period were £276, so that he had been living considerably in excess of his income. His business had not been successful, and in July he executed a deed of assignment, offering 5s. in the £, which was refused by the principal creditors. He had never been greatly pressed by creditors, and he alleged that, apart from the amount due to his father, he was not insolvent at the time of the petition, if the business could have been sold as a going concern. He admitted, however, that this must be taken into consideration, and, including his father's debt, he was aware of his insolvency about three years ago, and all his trade debts had been contracted with that knowledge. He hoped, however, for better trade. He had kept day-book, bought and sold ledgers and cash-book, but the cash-book was not posted up at the time of the petition. There was a difference required to balance the cash-book of £243 3s. 10d., which he accounted for as being travelling and personal expenses which he had not entered. He had taken stock, but had only roughly ascertained his financial position. The examination was closed.

ERNEST FENWICK JONES, plumber and electrical engineer, York Road, West Hartlepool.—A receiving order was made at Sunderland, on September 11th, on a creditor's petition.

D.P. Battery Contracts.—The D.P. BATTERY CO.'S contracts received during the past week include orders for the supply and erection at Howrah of a storage battery having a capacity of 800 KW.-hours, for the East Indian Railway Co., and another for New South Wales. In the home trade the company have secured contracts for 13 batteries for country house lighting installations, for the purpose of Government tests, and metal depositing work, as well as sundry renewal orders.

Factory Acts Prosecution.—At Dartmouth Police Court on Tuesday, last week, the Urban Electric Supply Co., Ltd., were summoned for an offence under the Factory Acts, it being contended that a lad named Owen Gurowich, 16 years of age, had on August 20th been employed in the generating station at Dartmouth at 8.30 p.m. during prohibited hours.—Defendants pleaded guilty, and were fined 1s. and costs.

Catalogues and Lists.—MESSRS. MANN, EGERTON AND CO., LTD., Norwich.—Small eight-page pamphlet entitled "Electric Light in the Country," giving illustrations of country residences where they have put down small electric lighting plants, and a specification of the latter together with prices of same.

THE WRIGHT SALES CO., Exchange Buildings, Briggate, Leeds.—Small pamphlet with illustrations, brief particulars and prices, of a number of electrical specialities, dry and medical batteries, massage vibrators, hand lamps, &c., for the current season.

MESSRS. W. N. BRUNTON & SON, Wire Mills, Musselburgh.—Twenty-page pamphlet just issued, of high-class steel wires both in straight lengths and in coils. The firm have endeavoured to bring together in one list all the special wires that are used. Sizes and prices are neatly arranged in tabular form.

THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., have issued a neat show card in colours for contractors and others to exhibit on their premises, letting the world know that "Royal Edison Metfil lamps" are "British made," and that they save 70 per cent of current. The pictorial feature consists of several vessels of the British Navy whose services are enlisted to give force to the above idea. Copies of the show-card, which measures some 21 in. high × 15 in. wide, can be obtained by sending trade card to the company's publicity department at Queen Street, E.C.

Messrs. L. Dens & Co., Place de Meir, 21, Antwerp.—This is a 40-page illustrated catalogue of the vitrified clay conduits of the H.B. Camp Co., of Pittsburgh, for whom Messrs. Dens are general agents for the Continent. Notes on underground conduit construction are followed with particulars of the Camp conduits, dowel holes and pins, mandrels and their use, repairs with split conduit, the suitability of the Camp conduits for high tension service, manholes and their construction, &c. A table of lengths and sizes of duct is given, also a list of some of the more important installations on this system in the United States and other foreign countries.

Messrs. Veritys, Ltd., London and Manchester.—A neat and compact radiator pamphlet of 32 pages has been issued for the current season. It is of pocket size, and contains small pictures (quite large enough to show the character of the different designs) of "Aston" luminous and non-luminous types of radiators. Several new designs are included, among them being the new pattern non-luminous radiator as used on H.M. battleships and cruisers. Prices and code-words are given, and an asterisk indicates whether the goods are held in stock. The list should be very handy for contractors and supply engineers.

The Electrical Co., Ltd., Charing Cross Road, W.C.—Several new publications, being sections of their catalogue, prepared in uniform size and style. Each contains brief descriptive material, and a good deal of tabulated data, including prices. The lists relate respectively to three, two and single-phase induction motors up to 6 h.p., lift controllers, and motor starters for continuous-current motors.

The Worthington Pump Co., Ltd., 153, Queen Victoria Street, London, E.C.—New catalogue of 44 pages, fresh from the press, in which descriptive matter, accompanied with a number of interesting sectional and exterior half-tone views, appears of the Worthington condensing apparatus—counter-current jet condensing plants with separate water and air pumps; Conojector condenser, without air pump, and with or without water pump; semi-counter current jet condenser and wet air pump; Multiflow surface condensers; exhaust oil separators, exhaust heads, exhaust relief valves; tubular heaters. A brief cable code is given at the end. The catalogue is produced in very fine style, and neither money nor pains has been spared in producing the excellent pictures. Power station engineers and other interested readers can secure a copy of the catalogue by writing to the above address.

Messrs. Pirelli, Ltd., 45, Basinghall Street, London, E.C.—New catalogue of cables and wires just issued, every article included in which are made by the well-known firm of Pirelli. The contents range from large-armoured cables to instrument wires, and they comprise paper-insulated lead-covered cables for light and power; air-space telephone and telegraph cables; and all types of rubber and gutta-percha cables, wires, and flexibles for every class of electrical service. Several types of telephone cables for indoor and outdoor work, cotton and silk-covered bell and instrument wires, also numerous accessories, such as tapes, ebonite sheets and tubing, &c., are detailed. In addition to the foregoing, Pirellis make to any practicable specification. Attention may be directed to some special extra-high-tension cables, which are shown, together with particulars of exceptionally severe tests to which they were subjected. The catalogue is arranged in a businesslike way, and where prices are given they are very plainly printed. Copies of the catalogue (32 pages) will be forwarded to any wholesale trade house upon application.

Messrs. Wm. Geipel & Co., Vulcan Works, 72a, St. Thomas' Street, S.E.—Price list and samples of Okonite and Manson insulating tapes, of which the former is offered as a substitute for rubber strip at a greatly reduced price.

National Electric Lamp Association (Engineering Department), 4,411, Hough Avenue, Cleveland, Ohio, U.S.A.—Bulletins No. 8a, dealing with tungsten miniature and low-voltage lamps for a variety of purposes; and No. 9, on the conservation of natural resources through the use of high-efficiency lamps.

The Electric and Ordnance Accessories Co., Ltd., Aston, Birmingham.—Catalogue (20 pages) dealing with the "Eclipse" electric cooking and heating apparatus. Notes on the advantages of the system, the general construction of the apparatus, heat regulation, and cost, are given, also pictures and prices of a number of electric kettles, hot water jugs and glue pots, hot plates, plate warmers, flat irons, Eclipse electric heaters, and other articles. Flexible wire and cable and wall plug and plug adaptor devices are not overlooked, and a page of figures appear stating the cost of operation of the different apparatus included in the list. In the Eclipse system the units consist of a special resistance material insulated with mica and enclosed in a thin metal casing. We are given to understand that this resistance material is quite able to withstand a temperature of 2,500° F. without risk of breakdown. We are informed that a number of kettles were placed in circuit for periods varying from 500 to 1,250 hours, and at the end of these periods not one of the units had broken down, nor were they the worse for wear to any appreciable extent. Most of the apparatus listed in the catalogue is capable of being adjusted to give from one to four different heats by a slight manipulation of the plugs. In addition to the apparatus listed, the company are shortly bringing out a series of apparatus for cooking by incandescent heat, such as grills, ovens, toast racks, &c. In these the units will consist of resistance material prepared specially for the Electric and Ordnance Co., and capable of being run at red heat for a considerable period. The company have been testing some units made up from this material, and they inform us that up to date they have run for 1,100 hours without showing signs of giving out. In addition to being simply run in circuit, quantities of water and grease have from time to time been poured on these so as to realise as far as possible actual working conditions. The result of this pouring on of water and grease is merely to cool down the units temporarily until the foreign matter has evaporated, and it is stated to have no injurious effect whatever. Copies of the catalogue can be obtained on application.

Messrs. Bruce Peebles Co., Ltd., Edinburgh.—Pamphlet (No. 20a) of 20 pages, devoted to the Peebles motor-converters (La Cour Patents). The principle of these machines is described, together with design and construction notes and explanatory diagrams. Motor-converters for either lighting or traction service, or both, are mentioned, as is also the inverted converter. A number of half-tone views show the machines in Manchester and other places. A tabular comparison appears of motor-converters with rotaries and motor-generators, and a list of important contracts is also given, these amounting to over 100,000 kw.

Mr. Chas W. Richardson, 159, Worsley Road, Patricroft, near Manchester.—Four-page circular describing the Richardson series adapter, and giving hints for fixing and a list of prices of accessories for same.

The J.L Manufacturing Co., Ltd., Johnson-Lundell Works, Southall, Middlesex.—Catalogue in expanding binder cover allowing for addition of later lists, in which many fine illustrations of the patent laminated-field J.L. dynamos and motors and their parts are contained. Accompanying them are priced sheets of standard protected-type motors for 230, 440 and 500 volts continuous current and compound-wound dynamos for 110 volts. Among the views is a large one of the interior of the company's works (machine shop), a low-voltage dynamo direct coupled to a high-speed oil engine, an adjustable-speed portable motor and switch equipment, and a 10-h.p. totally enclosed slow-speed motor driving a cold saw cutting H-iron beams. Copies of the catalogue can be obtained from those interested in this class of manufactures.

The Witton-Kramer Electric Tool and Hoist Co., Witton, Birmingham.—New leaflets describing their specialities. Leaflet K6 describes and illustrates electric polishing machines. Leaflet K7 describes the firm's standard type of electric winches, which are manufactured in all sizes from 1 h.p. to 50 h.p. Leaflet K8 shows two types of electric grinders, one for use in the tool rest of a lathe or milling machine, the other fitted with "long snout" and longitudinal feed for general work or for internal grinding. It has also been used for grinding commutators of large machines whilst the armature is still in the frame, but for this purpose it is usually fitted with a cross-traverse movement in addition to the longitudinal movement. Leaflet K12 describes "Witton-Kramer" flexible shafts, and gives prices of same, for transmitting power at awkward angles and for operating tools from portable motors in places where there is no line of shafting. Information as to the construction of the shafts, and regarding possible applications, is given. The company will shortly be publishing a list giving full particulars of a complete line of electro-lifting magnets that they are now designing.

Sydney Contract Deposits.—An Australian paper says:—"The Sydney City Council overruled the advice of its chief electrical engineer, and is calling for fresh tenders for turbine sets. Apart from the danger of overruling the advice of a highly-paid expert, the question of the deposits is worth more than passing notice. Tenderers for the turbines had to lodge a deposit of £1,000, and on acceptance a further deposit of £5,000, as a guarantee. The want of any finality in acceptance of the tenders practically locks up some £6,000 of each of the firms tendering. This is a point that should urge City Councillors, in all fairness, to waste no time in bringing the matter to a conclusion."

Trade Announcements.—Messrs. Isenthal & Co., of 85, Mortimer Street, Cavendish Square, W., announce that owing to the rapidly-increasing demand for the Moscicki high-tension condenser and the electric valve, they have taken additional premises at the same address in order to carry on the manufacture of these patents in England, and so to give quicker deliveries. They have at present in hand some very large Government and other contracts for Moscicki condensers, the former for wireless telegraphy, and the latter for the protection of overhead lines.

The Electrical League has removed its offices to Bank Buildings, Kingsway, London, W.C.

Messrs. Francis Reade & Co., electrical engineers and contractors, have removed to larger premises specially erected for them, at The Broadway, Church End, Finchley, N., where they have now opened a show-room for electric light fittings, shades, lamps, accessories, &c.

Dissolutions and Liquidations.—Under the compulsory winding-up order made last June against the Uxbridge and District Electric Supply Co., Ltd., Waterloo Road, Uxbridge, Mr. H. E. Burgess, Official Receiver, has now issued his report to the creditors and shareholders. The statement of affairs showed unsecured debts, £6,622; preferential claims, £89; loans on first debenture bonds, £35,000; on second debentures, £15,000; and interest, £2,579—making a total indebtedness of £59,291. The assets are valued at £75,039, or sufficient to yield, subject to realisation, a surplus of £15,748 after discharging the whole of the liabilities. They (the assets) consist of the following items, viz.: Cash in hand, £56; stock of coal, &c., £73; machinery, £15,454; mains, £25,204; transformers, motors, &c., £4,417; switchboards and instruments, £661; meters, £1,234; freehold site of generating station, £1,780; buildings, £8,277; trade fixtures, fittings, &c., £100; general stores and other property, £4,023; goodwill, £12,000; investments in shares, &c., £284; good book debts, £1,473; and bad debts, £387. The account with the contributories, however, discloses a deficiency of £10,527, which is accounted for as follows: Expenses of carrying on business from January 1st, 1906, to date of winding-up order, including interest on debentures, £8,505—£11,560. Losses and depreciation from January 1st, 1906, written

off in company's books, viz., bad debts, £142; preliminary expenses, £150. Losses and depreciation now written off, viz., loss, wiring department, £202; depreciation of undertaking, £20,694; less estimated value of goodwill, £12,000 = £8,694. Bad debts, £245; preliminary expenses, £893; discount on issue of £19,000 debentures, £1,900—total, £23,787. Less excess of assets over capital and liabilities on December 31st, 1905, £1,742; gross profit arising from carrying on business from January 1st, 1906, £11,517; transfer fees, £13,260—deficiency as per statement of affairs, £10,527.

The following is the text of the Official Receiver's report, viz.:—The winding-up order was made June 29th, 1909, on the petition of a creditor presented to the Court on June 17th. On the date of the winding-up order, Mr. John Conacher, general manager of the company and of the Metropolitan Electric Supply Co., Ltd., was appointed special manager for the Official Receiver. The company was promoted by Arthur Locke Radford, John Finnis Stilwell and William Frederick Thomas, assisted by Walter Avery Bird, the first secretary of the company, and was registered on June 24th, 1899, as the Uxbridge and District Development Syndicate, Ltd., with a nominal capital of £1,000 in shares of £5 each, the intention being to apply for a provisional order granting a monopoly for the supply of electricity in Uxbridge and the adjoining districts. The first directors were Radford, Stilwell and Thomas, and they, with Admiral Lord John Hay, Frank Bailey, James Carr Saunders and the Hon. J. B. Lubbock, who represent the Metropolitan Electric Supply Co., Ltd., constituted the board at the date of the winding-up order. Other directors have been William Potter, Harold W. Couzens, M. Binswanger-Byng, J. O. Callender, W. H. Cripps and F. Leverton Harris, who have resigned, and Col. W. G. Renton (deceased). The nominal capital was eventually increased to £75,000, divided into 10,000 ordinary and 5,000 6 per cent. cumulative preference shares of £5 each. 5,255 ordinary shares, representing £26, 275 have been allotted, the whole having been subscribed for in cash except 45 shares issued as fully paid. No preference shares have been issued. A provisional order, which was confirmed by the Electric Lighting Orders Confirmation (No. 12) Act, 1900, was granted to the company under which it received power to supply electricity in Uxbridge and the immediate neighbourhood. The area of supply was afterwards extended by further orders. The company's name was changed in April, 1901, to the "Uxbridge and District Electric Supply Co., Ltd." A prospectus was issued on May 30th, 1901, offering 2,650 £5 shares for public subscription, but only a small number (128) were applied for. The original shareholders received £1,000 for waiving the right they claimed to convert their holdings into founders' shares, and the money was applied by them in taking up 200 further shares in the company. Under an agreement dated March 26th, 1901, the General Electric Co. (1900), Ltd., agreed to make advances from time to time to the company not to exceed a total of £20,000, on the security of debentures. The agreement provided that orders for the plant and works necessary for the company's undertaking should be placed with the General Electric Co. at rates equal to 10 per cent. above competition prices. In May, 1901, the company acquired a freehold site at Uxbridge, and a generating station was built and equipped, and the laying of electric mains proceeded with. The approximate length laid is high tension 37½ miles, and low tension 11½ miles. The public supply of electricity commenced in May, 1902. The General Electric Co. by September, 1904, had subscribed for a total of £20,000 of debentures, and a further £3,900 were taken up by directors and the public. The debentures carried interest at a minimum rate of 4 per cent., and were exchanged in September, 1904, for others bearing interest at 5 per cent. The company at the same time issued debentures for £3,000 to Callender's Cable and Construction Co., Ltd., in payment of a debt. In May, 1905, the General Electric Co. held debentures for £21,500, and also 320 shares (£1,600), and Callenders held debentures for £3,000 and 730 shares (£3,650). By an agreement of May 8th, 1905, in consideration of the company withdrawing its opposition to a Bill in Parliament, the Metropolitan Electric Supply Co., Ltd., agreed, in the event of the Bill receiving the Royal Assent, to acquire the interests of the General Electric Co. and Callenders, and to take up an additional 500 shares in the company. The Metropolitan Co. were also to have a right to nominate directors up to four in number. This arrangement was duly carried out in December, 1905, and the Metropolitan Co has since taken up further debentures for £19,000, viz., first debentures £4,000, and second debentures £15,000, which were issued to them at a discount of 10 per cent. The total debentures issued by the company amount to £50,000, of which £43,500 are held by the Metropolitan Co., and £6,500 by the directors and the public. The total capital expenditure of the company in connection with its undertaking, according to the accounts for the year 1908, was £81,358 10s. 8d., being £7,183 10s. 8d. in excess of the share and debenture capital subscribed. The result of the company's trading (before charging interest on debentures and bills) has been as follows:—

1901	... ...	Profit £15
1902	... ...	Loss 90
1903	... ...	Profit 687
1904	... ...	do. 1,467
1905	... ...	do. 987
1906	... ...	do. 1,531
1907	... ...	do. 2,818
1908	... ...	do. 2,903

No dividends have been paid. The company was unable to pay the interest due on debentures for the half-year ending December, 1908, or to meet its other liabilities. Upon the presentation of the petition to wind-up, the Metropolitan Co. commenced an action, and on July 20th, 1909, the Court appointed the Official Receiver as receiver for the debenture-holders. The assets of the company, apart from the unexpired term of the provisional orders (but including the cost of the provisional order) are valued in the statement of affairs at £63,038 16s. 2d. The goodwill, including the unexpired term, is included by Radford & Hitchens at £12,000, but James Carr Saunders, who concurs in the statement of affairs, values the goodwill at £5,000. Unsecured creditors, returned at £6,622 4s. 5d., are in respect of electric cable supplied, £5,860; bank overdraft paid off by directors, £558; goods sold and work done, £182; insurance, £22—total, £6,622. Preferential creditors returned at £89 8s. 6d. are for rates, salaries and wages. The failure of the company is attributed by the directors to want of working capital, and to loss of business caused by the closing down of customers' works.

As a result of the statutory first meetings of creditors and contributories, held on July 29th, 1909, the Official Receiver remains the liquidator of the company with a committee of inspection.

Cylantha Publishing Co., Ltd.—This company is winding up voluntarily, as it cannot by reason of its liabilities continue the business, with Messrs. A. G. Wright and J. Strahan Smith, 165, Queen Victoria Street, E.C., as liquidators.

Poole and District Electric Traction Co., Ltd.—A meeting is to be held at Electrical Federation Offices, Kingsway, W.C., on October 11th, to hear an account of the winding up from the liquidators, Messrs. E. Garcke and W. F. Cox.

International Telescriptor Syndicate, Ltd.—A meeting is to be held at Norfolk House, Strand, W.C., on October 14th, to hear an account of the winding up from the liquidator, Mr. R. H. Hoare.

Premier Accumulators.—The Premier Accumulator Co., have recently completed an extension to their works to cope with increasing business. They have recently secured orders for 56 lighting type cells for Lord Rosebery, 55 lighting type cells for Lord Fitzwilliam, a lighting battery of 56 cells for Melbourne, and another lighting type battery for India, together with 264 cells in lead-lined wood boxes and automatic reversible booster and switchgear for the Wallasey U.D.C. with 10 years' maintenance.

Bravo, Callender!—The two following interesting items of Continental information have reached us this week:—"There was keen international competition for the contract for the supply and laying of the mains required in connection with the electric lighting and power installation at the Harbour at Ostend, tenders being received from British, German and Belgian concerns. The contract was divided into two lots. For one of them the Callender's Cable and Construction Co., Ltd., of London, succeeded in submitting the lowest offer; for the second lot their quotation was slightly higher than that of the Land und See Kabelwerke Gesellschaft, of Cologne."

"A dozen firms submitted tenders to the Société Nationale des Chemins de Fer Vicinaux for the supply and installation of the underground continuous-current feeders required for the Brussels-Dilbock electric railway. No fewer than nine German concerns, one Austrian, one Belgian, and one British, competed for the contract, the lowest offer being that of Callender's Cable and Construction Co., Ltd., London."

LIGHTING and POWER NOTES.

Aberdeen.—Legal action has been taken by the Electrical Contractors' Association of Great Britain under the Electric Lighting Act of 1905 in regard to the new works at the City Hospital. The Association complain of the Corporation executing work on the consumer's side of the meter. The point will shortly come before the Courts.

Accrington.—At the T.C. meeting last week Ald. Higham, chairman of the Electricity Committee, referred to the success which had attended the electrical exhibition in the Town Hall. Some 13,250 persons had paid for admission up to Saturday, and the total receipts amounted to £110. No doubt it would mean some loss to the Corporation, but the increased use of electrical energy would repay them for their trouble and expense.

Acton.—The Council decided in May last that the price of electricity for lighting should be 7d. per unit to consumers on free wiring installations, and 6d. per unit to all other consumers. Last week a meeting of the Council was held to consider applications from shopkeepers to be supplied at a special rate. Of the 581,809 units consumed last year, it was mentioned that 145,138 units were consumed by shopkeepers, factories, and places of worship. Finally it was resolved, by four votes to three, that after October 1st, shopkeepers (including factories), should be charged on a flat rate of 5d. per unit.

Amble.—At a meeting of the U.D.C. on the 8th inst. the question of lighting the town by electricity was further considered. A vote of ratepayers had been taken, and the result was that nearly two to one voted in favour of electricity. It was decided to employ an expert to examine and report on the scheme, and then a further vote will be taken.

Barrow-in-Furness. — The report of the electrical engineer for the year ending 1909 shows that 1,057,330 units were sold, an increase of 10,000 units on the previous 12 months, and that the maximum load fell somewhat to 884 KW. The equivalent of 78,119 8-C.P. lamps was connected, and this included 152 motors of 1,004 H.P., the apparatus on hire including 14 motors, 29 radiators, 52 irons, 9 water heaters, 23 kettles, and 5 arc lamps. Although there was a considerably reduced output for both lighting and tramways, the new connections in lamps, or their equivalent, were much above the average.

Bexhill.—The L.G.B. has sanctioned the Council's application for a loan of £2,120 for condensing plant, cooling tower, &c., so far as it relates to borrowing £1,990, to be repaid within 21 years. The board has deducted sums amounting to £130 in respect of outstanding work.

Another application is to be made for a loan of £197 for small extensions.

Bray.—At the meeting of the Urban Council last week, a report from the Electric Lighting Committee was read, from which it appeared that the Committee asked for leave to formally apply for a loan of £1,000, sanction to substitute a 50-H.P. Diesel oil engine for the gas engine, and instructions to the engineer to prepare specifications, &c. Mr. Bradshaw explained that the £1,000 was not an extra loan. It had been already granted, but they wanted to utilise it in a more beneficial way, and it was necessary to get the formal sanction of the L.G.B. The report was adopted.

Canada.—The fight between the electrical interests and the Hydro-Electric Commission, has reached almost a final stage, Major J. A. Murray, of Toronto, having issued a writ which is based on the original rights of the Ontario Power Co, and the Ontario Government, as regards the use of Niagara water. Major Murray seeks an injunction to prevent the expenditure of money on the scheme, and the pledging of the credit of the province of Ontario and Toronto municipal corporation in carrying out the contract to purchase electrical energy developed from the Niagara River, on the ground that the water is within the exclusive control and jurisdiction of the Dominion Government; that its use by the Ontario Power Co. is without sanction of the Government, and therefore illegal, and that, therefore, the Hydro-Electric Commission, in carrying out a contract with the company, is illegally spending money and pledging public credit. It is suggested that as the Dominion Government rights are involved, the Solicitor-General may take action.

Carlisle.—The Electricity Committee of the T.C. has agreed to supply steam to the Baths Committee at 1s. 0¾d. per 1,000 gallons. It has also been agreed to run an aerial transmission (estimated to cost £800) to Holme Head, to supply Messrs. Ferguson Bros.' new works, and to lay a feeder from the power station (estimated to cost £1,750) to Messrs. Cowans, Sheldon and Co.'s works.

Cowdenbeath (Fife).—At a meeting of the T.C. a letter was read from the Fife Electric Power Co., asking the consent of the Council to the inclusion of the burgh in the district for which the company intends making application for a provisional order. The Corporation means to promote its own order, and therefore agreed not to meet the company.

Darlington.—The T.C. has received from the L.G.B. sanction to a loan of £2,187 for the provision of a 500-KW. generating set.

Edinburgh.—The Marine Gardens have recently been brought up to date by the outlining of the various buildings with electric lamps. Over 10,000 lamps are now in use, 8,000 additional ones having been installed during the past few weeks.

Hayti.—It is stated that negotiations are proceeding with a Belgian group, which, with the participation of a leading German electricity company, proposes to establish electric supply works for the cities of Port-au-Prince and Cape Haytien, in the West Indies. The Government of Hayti has promised to support the scheme.

India.—The Government of Bengal has approved of the agreement entered into between the Maharaja of Mourbhanj and the British Westinghouse Co. for the establishment of a plant to utilise the water-power of the River Barabolang in the Mourbhanj State in the generation of electrical energy for lighting and power purposes.

Lanarkshire.—A new cement manufactory of the Coltness Iron Co., Ltd., at Newmains, has recently been started for making cement from waste furnace slag. A travelling electric crane takes an 8-ton ladle of molten slag from the furnace to a "tipler," worked by an electric motor. An aerial electrically-operated railway conveys the material to the clinker-house; thereafter all the processes in the mills are operated by electricity. A 1,750-H.P. gas engine generates energy for the mills at 2,500 volts, and utilises the waste gas from the blast furnaces. Each pair of mills in the cement works has a separate motor of 350 E.H.P.; and a motor of 150 E.H.P. drives all the conveyors, elevators, &c. The aerial ropeway is driven by a turbo-generator worked by exhaust steam. The feature of this cement factory is that the whole of the installation is derived from the waste product of the blast furnace, viz., the slag which is converted into Portland cement, and the power for driving the machinery which is obtained from waste gases and exhaust steam.

London.—BETHNAL GREEN.—A special meeting of the Council is to be convened for the 30th inst., to consider in committee the matter of the supply of electricity in the borough. Quotations have been sent in from adjoining authorities and companies, and it was recommended by the committee that negotiations be opened up with Hackney, but this recommendation was not agreed to by the Council at the meeting on July 15th.

An electrical exhibition which is being promoted by the Shoreditch, Hackney and Stepney B.Cs. is to be held at the Pitfield Street Baths, Shoreditch, from October 18th to 30th.

Long Eaton.—At a meeting of the U.D.C. on Monday night the engineer reported an increase of 36,285 units, or 47 per cent. generated. It was recommended that the discount on the quarterly accounts for payment within one month from date of demand be increased as follows:—5 per cent. on accounts under £25; 7½ per cent. on £25 and under £50; £10 per cent. on £50 and under £75; 12½ per cent. on £75 and under £100; and 15 per cent. on £100 and upwards. After some discussion this was agreed to.

Melbourne.—The P.C. has accepted the tender of the Midland Machine Trust Co., Ltd., for current for 26 tantalum lamps at 15s. each for the lighting season, and for arc lamps at £4 each.

Newcastle (Co. Down).—At the monthly meeting of the Urban Council, held on the 6th inst., Messrs. J. W. Fraser and Co., Lewisham, gave notice that they were applying to the B. of T. for a provisional order for electric lighting. The Council decided to ask for further particulars as to the proposals.

Peterborough.—The T.C. has offered to supply energy to the cable company which contemplates having works at Woodstone, at 1 1/16d. per unit up to 750,000 units per annum, and 1d. per unit beyond. The company undertakes to consume at least 500,000 units per quarter, and it is estimated that the cost of additional plant, &c., to cope with the supply will be £13,875.

Stretford.—The Electricity and Tramway Committee having failed to come to an agreement with the Manchester Corporation as to the price of electricity supply for increased tramway service, consequent on the opening of the United's football ground, the Committee has decided to place the matter before the L.G.B., with a request that an arbitrator should be appointed. Instead of going to the heavy cost of extending its own electricity works for the purpose of providing the necessary energy for the increased traffic, the Stretford authority desires to obtain the power from the Manchester Corporation, which has fixed the price at 1d. per unit for traction consumption, subject to an adjustment in respect of the price of coal, this arrangement to remain in force until March 31st, 1912.

Uruguay.—The municipal authorities of Carmelo and Villa del Rosario have recently decided on the establishment of central electric lighting stations in their respective towns.

Watford.—Relying on the passing of the E.L. Amendments Act in Parliament, the U.D.C. has decided to delete from its Bill, Clause 36, which seeks to give the Council power to supply fittings, &c.

Worcester.—The T.C. has decided to replace 78 gas lamps and three small lamps, giving from 3,000 to 3,500 C.P., in Barbourne, London, and Bath Roads, with 12 arc lamps and 57 Osram lamps, giving 13,530 C.P., at a cost of £250 per annum, against £229 4s. 6d. for gas.

It is proposed to apply to the L.G.B. for sanction to a loan of £656 for coal storage and handling plant at the Hylton Road electricity works. It was agreed, however, to repay the amount out of revenue in five years.

Worthing.—The L.G.B. having deducted £337 in respect of meters from a loan applied for, the T.C. has asked that the present application be acceded to as, owing to previous loans for meters having been obtained, money has been expended on account. The Council has made arrangements to meet the cost of meters out of revenue account in future. The other part of the loan applied for, £2,300 for mains and £1,250 for house services, has been sanctioned.

Yarmouth.—At a meeting of the T.C. on Tuesday, a letter was read from the L.G.B. with reference to the application of the Council for sanction to borrow £2,000 in respect to the alteration of the system of public lighting in the borough from gas to electricity in certain streets, stating it was not the practice of the Board to sanction loans for undefined expenditure in public lighting, and it was not satisfied that the substitution of electricity for gas would result in any economy or improved lighting.

TRAMWAY and RAILWAY NOTES.

Argentine.—It was recently announced that the firm of Th. Bracht & Co., of Antwerp and Buenos Ayres, had applied to Congress for a concession for the construction of an underground electric railway in Buenos Ayres. It is now stated in this connection that the firm in question is acting in conjunction with the

Banque de Reports, de Depôts et Fonds Publics of Antwerp, and the Union Anversoise de Tramways et Enterprises Electriques. A similar offer had previously been made by the Western Railway, and now Ricardo R. Lédola is seeking for a concession on behalf of the contractors for the Paris Metropolitan Railway. It is said that the city of Buenos Ayres appears to desire to arrive at a speedy solution of the question mainly in consequence of the large amount of traffic.

Ayr.—Mr. Wm. Grant, the general manager, in the course of his annual report on the working of the Ayr Corporation Tramways, states that the total revenue for the year was £15,081, compared with £15,322 in the preceding 12 months. The traffic receipts amounted to £14,444—a decrease of £312. The receipts per car-mile worked out at 8·87d., as compared with 9·13d. for last year. The number of passengers carried was 3,610,537, a decrease of 49,501. Of the receipts 29 49 per cent. were from ½d. fares, 17·27 from 1d. fares, and 24 41 from 2d. fares. The surplus for the year, £62, was carried to the burgh general assessment. The capital expenditure now stands at £82,169, the depreciation and renewals fund amounts to £13,110, and in addition, there is a reserve fund of £5,000.

Brentford.—At the last meeting of the Guardians it was reported that the bill of costs of the London United Tramways Co. with regard to its appeal against the assessment of its property in the Union was £6,699. This had been reduced on taxation to £3,832, and the Guardians made an order for the payment of this sum.

Continental Notes.—Spain.—A concession for the construction and working of an electric tramway in the city of Vigo and suburbs has been applied for. The Direccion General de Obas Publicas, Madrid, invites tenders until November 3rd, for the construction and working of an electric tramway to run from Calle de Villanova to Calle de Wad-Ras, in Barcelona. An application respecting this concession has already been submitted by the Sociedad Anonima Tranvias de Barcelona á San Andrés y Extensiones, who have certain preferential rights in the competition. Don Carlos E. Montanés has been granted a concession for the construction and working of the Metropolitan Electric Railway at Valvidrera. It appears that the work will involve the boring of a tunnel. Two years are allowed for the completion of the work, excluding tunnel operations.—*Board of Trade Journal.*

Austria-Hungary.—The district authorities of Hohenfurt have arranged to construct as soon as possible an electric railway from Zartlesdorf to Lippnerschwebe. The cost of construction is assessed at 3,000,000 kronen (£125,000), to cover two-thirds of which it is proposed to issue a loan.

Russia (St. Petersburg).—A further stage has been reached in connection with the tramway question in the Russian capital, inasmuch as a St. Petersburg correspondent states that according to the scheme placed before the Municipal Council by the Tramway Committee, it seems almost impossible that the Council will entertain the offers made by private companies to construct and work the lines of second-class of a total length of 64 versts. The total cost of construction is estimated at £4,200,000, the annual receipts at £1,430,000 and the working expenses at £830,000. The interest service of the proposed loan, including redemption, would require £288,700, and the renewal fund would need £84,000, so that the profit surplus of £600,000 would be reduced to £227,300 per annum, which, in the opinion of the Committee, would allow of the payment of a dividend at the rate of 4½ per cent. on the ordinary capital expenditure.

Bavaria.—The Bavarian State Railway authorities have decided to convert the railway between Salzburg, Reichenall and Berchtgesgaden to electric traction. In connection with the scheme, a large electric power generating station is to be established at Ribling.

France.—The railways radiating from Paris to Versailles, St. Germain, and Argenteuil are to be electrified at a cost of £6,000,000. The work is to be completed in 10 years.

Germany.—The Prussian State railway authorities have placed a new order for the delivery of 33 storage battery motor coaches for use on various sections of the railways, which are already equipped with 62 accumulator cars. It was stated that as a result of the practical working of the latter they have been found free from objection, and that passengers give a preference to travelling in them. In addition to this type of self-contained coach, the railway authorities have in operation some steam motor coaches of a special kind, as well as a petrol-electric coach. If the latter two classes should prove to be reliable, they would probably only be extended where the storage battery cars are not applicable on account of the limited distance which they are able to cover without the necessity of re-charging the batteries.

Glasgow.—The Tramways Committee recently recommended that an experimental direct service of cars should be given between Townhead and the West-end of the city for four months. In the course of the discussion in the T.C., it was pointed out that several new cross routes were working at a loss, six of them accounting for a deficit of £17,500. In the end the recommendation was disapproved.

Immingham.—The Grimsby R.D.C. has passed the plans of a light railway, to be worked by electricity, between the new deep water dock at Immingham and Grimsby. The scheme will be completed in January next.

London.—Lt.-Col. Druitt's report, on behalf of the B. of T., in connection with the collision which occurred at Moorgate Street Metropolitan Station on August 5th, which was recently issued, shows that the accident was due to the failure of an automatic signal to return to the danger position, behind a train which occupied the track section in the station. The Johnson All-electric Automatic system has recently been installed, and Mr. H. G. Brown, chief engineer to the Signal Co., suggests, in his evidence, that the probable cause of the signal remaining in the clear position was an accumulation of sediment in the oil, which caused the release valve (in the operating oil cylinder on the signal) to stick, and so prevented the signal going to danger when the magnet controlling the release valve was de-energised by the track circuit being interrupted. The release valve is to be re-designed.

The L.C.C. tramway route from Holborn to Hampstead, *via* Camden Town, was opened throughout for traffic on Friday last.

The Willesden U.D.C. has decided to oppose the joint scheme of the L.C.C. and Middlesex C.C. for a tramway from Marble Arch to Cricklewood unless certain road-widening is agreed to.

Pudsey.—On Wednesday last week, owing to the failure of the brakes on a car which was running round a curve, the car jumped the track and ran into some shop fronts; one passenger was injured.

South Africa.—The East London T.C. (Cape Colony) has resolved to lay a new tramway at an estimated cost of £8,500.—*Commercial Intelligence.*

South Shields.—The Tramways Committee suggests making an experiment with regard to the fares on the market place and seaside line, which is regarded as the most unremunerative part of the system. There are no halfpenny fares in the town, but the Committee proposes to introduce a system of penny return tickets on the section named during a trial period of 12 months.

Wolverhampton.—The Lea Road section of the Corporation tramways was completed at the beginning of last week, a trial run took place on Wednesday, and the line was opened for traffic on Friday afternoon, and has since been well patronised. Provisional permission was given by the Board of Trade to open the line prior to the official inspection on condition that the Corporation took all risks; the insurance company interested also gave their sanction to running the cars for traffic, and the Tramway Committee decided, therefore, to commence operations at once. This section completes the whole of the lines now proposed to be laid down by the Corporation, though another tramway is very much needed in the direction of Stafford New Village and Fallings Park Garden City, which are becoming densely populated. The contractor for the Lea Road line, it may be mentioned, was Mr. Trentham, of Handsworth and Smethwick, and he has done his work well.

TELEGRAPH and TELEPHONE NOTES.

Argentine Cables.—It is understood that the River Plate Telegraph Co. has made an offer to the Argentine Government to lay free of cost a cable between Buenos Ayres and Europe *via* Tristan da Cunha. The Western Telegraph Co. and its associates appear to be determined to meet any possible opposition or competition by the German cable scheme in a workmanlike and effective manner. An American contemporary states that the Western Telegraph Co.'s contract with the Argentine Government for the laying of a cable between Buenos Ayres and Ascension provides that if within a period of 25 years from the date of the completion of the agreement any company should make proposals to the Government, which would appear advantageous to the latter, for the laying of a new submarine cable between the Argentine Republic and another country, preference will be given under the same conditions to the Western Co. The agreement provides for a monopoly in official messages and all unrouted traffic collected by the Government telegraph offices. The agreement also accords freedom from all import duties and taxes for 25 years. The company in return for these privileges reduces rates on messages *via* Brazil by 15 centavos per word.

Cable Interruptions and Repairs:—

	Interrupted.	Repaired.
Tangier-Cadiz	May 19, 1909	
Tourane-Amoy	June 17, 1909	
Assab-Perim	July 8, 1909	
Gibraltar-Tangier	Aug. 7, 1909	September 10
Dakar-Conakry	Aug. 20, 1909	
Balikpapan-Kwandang	Sept. 2, 1909	

The German Cable to Brazil.—The section of the cable between Emden-Borkum and Teneriffe, as previously announced, was recently completed and was opened for traffic on August 26th. It belongs to the German South American Telegraph Co., of Cologne, which was formed in August, 1908, to establish a connection with Brazil. The laying of the land cable was commenced in the following month, and the length to Borkum was completed at the end of November. The marine cable to the end of the canal at Emden was finished in June of the present year, whilst the cable to Teneriffe, of a length of 1,698 miles, was started on July 26th by the cable steamer *Stephan*, the work having been carried out by the Norddeutsche Seekabelwerke, of Nordenham. The station at Teneriffe is located at Santa Cruz and the staff is composed of Germans. It is probable that the continuation of the cable to Brazil will not take place before the beginning of next year.

It has not yet been decided whether the direct route to Pernambuco will be chosen or whether an intermediate landing will be effected at Monrovia in Liberia, the latter way being about 1,000 nautical miles longer and consequently necessitating greater expenditure. But as in any case a connection is to be established with West Africa the latter route will, perhaps, be given the preference. In this event a branch cable would be laid to the German colonies of Togo, the Cameroons and South-West Africa, by means of which German communication with Africa would be completely independent of British cables. It is also calculated that Portugal and the State of Congo would utilise the cable, as they have, it is said, manifested great interest in an improvement of the present cable connections. By means of a direct cable between Emden and Pernambuco, it will be possible to reduce the charge by 6d. per word. Efforts are already being made in Brazil to extend the cable from Pernambuco to Buenos Ayres, which prolongation is deemed to be necessary in German interests. The subsidy granted by Germany has been so arranged that interest on the working capital will not only be paid but the capital will also be redeemed. The completion of the Teneriffe cable has increased the total length of German transmarine cables to about 17,980 miles.

Glasgow.—A new central telephone exchange is being constructed at the Waterloo Street branch of the Post Office on the common-battery system. This exchange will have provision for 10,000 subscribers, and is expected to be ready about the end of this year.

High-Speed Wireless Telegraphy.—On Saturday and Monday last an interesting demonstration of the Poulsen system of wireless telegraphy took place at the Cullercoats station. As our readers are aware, this station was erected by the Amalgamated Radio-Telegraphic Co. to test on a working scale the Poulsen system of telegraphing with undamped waves, the corresponding stations being at Esbjerg and Lyngby, in Denmark; the latter station was in communication with Cullercoats last week-end, over a distance of 600 miles, the sending power being 3 or 4 KW. We gave a description of the ordinary Poulsen equipment of the Cullercoats station in our issue of July 9th last, in the form of an abstract of a paper read before the Institution of Electrical Engineers at Newcastle by the engineer in charge of the station, Mr. A. S. M. Sörensen. The Poulsen arc takes from 7 to 10 amperes at 340 volts from the town mains, and generates oscillations having a frequency of nearly 200,000 cycles per second, the current to the antenna being about 9 amperes, and the wave length about 1,800 metres. The antenna is coupled direct to the sending circuit, and the transmission is effected by short-circuiting a few turns of inductance in the circuit, thus changing the wave length slightly, the sparking at the key being insignificant and almost noiseless. Signalling over a distance of 400 miles has been accomplished with as little as 200 watts. Receiving is effected in ordinary working with a telephone connected to the Poulsen "ticker," which allows the waves to accumulate by resonance in the secondary circuit, and intermittently discharges the stored energy through the telephone, no coherer or detector being required and very loose coupling being employed, so that the tuning is very exact. For the high-speed transmission an automatic sender is used, with punched tape as in the Wheatstone system; the only example of this sender as yet in use is set up at Lyngby. The receiver consists of a photographic recorder embodying the Edelmann string galvanometer and a crystal rectifier, consisting of particles of galena and tellurium in contact, which permit the waves to pass in one direction only. This is in series with the string galvanometer and the receiving circuit. A shadow of the "string"—an excessively thin gold wire stretched in a strong magnetic field—is projected by a Nernst lamp and lenses on a slit in front of a sensitised paper tape, which passes from the slit through developing and fixing baths, the apparatus being driven by a small motor provided with an eddy-current brake to ensure steady running. The vibrations of the "string" cause its shadow, projected on the paper, to produce a trace resembling somewhat the record of a siphon recorder, extremely clear and easy to read. With this apparatus signals were received at speeds of 50 and 100 words per minute with satisfactory results. The power employed was 7 or 8 KW. at Lyngby. It is anticipated that when the trans-Atlantic stations are completed—one of which is partly erected in Ireland—it will be possible to send 50 words a minute and to record the messages received, with a sending power of 100 H.P. The speed from Lyngby has reached 125 words per minute, or five times the speed claimed for hand-operated wireless transmission up to the present.

For ordinary commercial messages to ships the De Forest spark system is used at Cullercoats, with the electrolytic detector, and a wave-length of 600 metres. A new experimental wireless station has recently been erected at the Armstrong College, Newcastle-on-Tyne, and equipped with the Poulsen apparatus, so that communication can be carried on with the Cullercoats station; the Poulsen system is particularly well adapted for wireless telephony, and experimental work in this and other directions will be carried on between the two Tyneside installations.

Norway.—The telegraphic system in 1907-8 increased over the previous year by 232 km. of line, and 727 km. of wire, to 10,469 and 20,689 km. respectively; while the increase of the telephone system was 345 km. of line, and 3,327 km. of wire, to 5,595 and 96,779 km. respectively. In the above year there were 969 offices in Norway, an increase of 53 on the previous year; and the telephone subscribers increased from 17,453 to 18,602, but the majority of these were located in Christiania. The service was worked by 1,387 permanent employés, while 3,318 temporary employés were also engaged. The telegraphic traffic was 2,819,657 messages, an increase of 8·1 per cent. on the year 1906-7. Only 529 complaints of errors in transmission were made. The number of telephonic conversations increased from 49,086,660 to 52,476,527, and the total telegraphic and telephonic receipts amounted to 5,679,356 fr. The expenses of both systems amounted to 3,995,158 fr.—*Journal Télégraphique.*

Pacific Cable.—The report of the Cable Board for the year ending March 31st last shows that the traffic receipts for the year were £114,825, less the Atlantic Companies' charges, £3,763 the net receipts amounted to £113,093. Deducting the expenditure a balance of £16 657 was left, which was applied to the reduction of the amount (£77,544) due for interest and sinking fund, leaving £60,888 to be subscribed by the Governments concerned, as compared with £62,362 for the previous year. The traffic receipts showed an increase of £1,425, and the total receipts an increase of £2,933, while the expenditure increased by £1,458, due to the normal increase of salaries and to the fact that almost all the staff became entitled to long leave. The renewal fund stood at £192,595; with interest on investments (£7,000) and appropriation from revenue (£30,000), the fund is growing at the rate of £37,000 a year. Serious interruptions occurred on the Canadian landlines and one of the Australian landlines. The speed of the duplex transmission on the Bamfield-Fanning section has been increased to 90-97 letters a minute, whereas it was originally anticipated that the practical working speed would not exceed 65 letters; as this is the slowest section, the capacity of the whole system is correspondingly improved. The cable has given no trouble. The messages last year numbered 232,304 ordinary, 9,086 Government, and 2,532 Press messages, the total being 243,922, as against 249,590 in the preceding year. The total capital expenditure was increased by less than £500 during the year, to £1,999,100.

South Africa.—NATAL.—The annual report for the past year of the Natal Telegraph Department has just been issued, and shows that the telegraph receipts for the year ended June 30th, 1908, amounted to £42,404, as compared with £45,623 for the previous year, being a decrease of £3,219. During the year ended December 31st, 1908, the number of telegrams passed over the department's lines were 1,518,148, as compared with 1,579,061 for the previous year. Three additional offices were opened during the year, the total now being 212. The telephone receipts totalled £9,587, as compared with £8,682 for the previous year; the trunk revenue shows a steady increase, accounted for in great measure by the adoption of the 1s. 6d. uniform rate for three minutes' conversation.

TRANSVAAL.—A heavy snowfall on August 17th did much damage to telegraph lines. Natal was cut off from Johannesburg, and one of the Cape lines, through Kimberley, *via* Bloemfontein, had to be used for communication with Natal.

Switzerland.—A new telephone line to the summit of Mont Rosa was inaugurated last week. It places the Observatory, at a height of about 15,000 ft., in communication with the telephonic exchanges in the Aosta Valley.

Underground Wires.—The Postmaster-General, says the *Times*, has decided to proceed at once with the work of placing the Post Office telegraph wires underground between Chatham and Dover. The telegraph wires between Chatham and London are already underground.

United States.—It is reported by a correspondent of the *Financial News* that the American Telephone and Telegraph Co. is negotiating to purchase the control of the Western Union Telegraph Co., which has hitherto worked in conjunction with the Anglo-American Telegraph Co. If the deal is effected, it is suggested, the Western Union traffic will be diverted to the Commercial Cable Co., both of these being Mackay companies, and the Anglo-American Co.'s traffic will be confined to New York.

Wireless Telegraphy.—It is reported that the German Colonial Office authorities are negotiating with the Telefunken Gesellschaft with a view to the establishment of means of communication by wireless telegraphy between Berlin and German colonies. It is proposed, in the first place, to raise the height of the Nauen station by about 160 ft., and experiments are to be made this year between this station and a ship proceeding to the Cameroons. If it is found possible to effect a connection between Nauen and the coast of the Cameroons, it is intended to link together the remaining German colonies in Africa so that they will be able to communicate with the Fatherland by way of the Cameroons.

An official from Marconi's Wireless Marine Communication Co. is in Durban with the object of making experiments with a view to the establishment of a wireless telegraphic service between South Africa and this country. According to the *Standard*, this is part of a scheme which the company are endeavouring to execute as quickly as possible—that of establishing wireless telegraph stations between the Home country and all her colonies. The idea is to establish stations at distances of about 2,000 miles apart, for the purpose of transmission. The total cost of linking up the Empire by wireless, involving the erection of 24 stations, will be about £1,320,000. Each station will cost £55,000 in outlay, and £10,000 yearly for upkeep. The estimated income per station per year is £22,500, or a total of £540,000 yearly, which provides for a handsome profit.

A wireless telegraph station is being erected close to the sea at Simon's Town.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Victoria.—100,000 porcelain insulators for the P.M.G. See "Official Notices" September 10th.

Telegraph and telephone material for the P.M.G., Melbourne. See "Official Notices" September 10th.

Common battery switchboard for the North Sydney Telephone Exchange. See "Official Notices" September 10th.

Sydney.—The Australian Postmaster-General has ordered cables and wires to be obtained by tender to the value of over £17,500, within the current financial year.—*Commercial Intelligence.*

Belgium.—September 28th. La Société Nationale des Chemins de Fer Vicinaux of Brussels (14 Rue de la Science) are inviting tenders for the supply and erection of the overhead equipment for the Anderlues-Lobbes section of the Carnieres-Thuin electric railway.

November 6th. The municipal authorities of the town of Tongres are inviting tenders for the extension of the central electric lighting station. Plans and specifications can be obtained from the Hotel de Ville on payment of 8 francs.

Bristol.—September 21st. E.L. installation at Alexandra Park Schools, Fishponds, for the T.C. (deposit £2 2s.); Rodway and Dening, architects, Gaunt House, Orchard Street, Bristol.

Burnley.—September 20th. The Guardians are inviting tenders for electrical supplies to the workhouse. Particulars from the Clerk, to whom tenders must be sent by the 20th inst.

Canada.—Toronto.—October 14th. A New York Exchange says that the city of Toronto is inviting tenders for four 1,500-H.P. synchronous motors, two 1,500-H.P. induction motors, four 500-H.P. induction motors and two 225-H.P. synchronous motors, with exciters, switchboards and connections; also for a number of large-sized turbine pumps, piping, valves, &c.

Corea.—It is reported that the Japanese authorities have decided to construct new telephone lines in Corea to the length of 500 miles, at a cost of 70,000 yen (about £7,150).—*B. of T. Journal.*

Dudley.—September 28th. Electrical fittings for six months, for the B.G. C. W. Coster, clerk, Union Offices, Dudley.

Epsom.—September 25th. 850 tons washed nuts for the U.D.C. electricity works. Engineer, Mr. A. C. Gilling.

Fulham.—September 22nd. 150 electricity meters for the Corporation. See "Official Notices" September 10th.

Glasgow.—One electric passenger lift and three electric book lifts for the new Mitchell Library. Specifications and forms of tender from Mr. W. B. Whitie, 219, St. Vincent Street.

Isle of Thanet.—Stores for the Isle of Thanet Electric Tramways and Lighting Co., Ltd. See "Official Notices" September 3rd.

London.—L.C.C.—September 21st. Two 500-KW. and 150-KW. motor-generators, also high and low-tension switchgear, for sub-stations; steam and other piping, valves, &c., for Greenwich generating station. See "Official Notices" August 27th.

Manchester.—September 21st. Steel girder tramway rails, for the T.C. (deposit, £1 1s.). J. M. M'Elroy, general manager of the tramways, 55, Piccadilly.

Oulton Broad.—The U.D.C. invites applications from those willing to carry out its E.L. order. See "Official Notices" September 10th.

Walthamstow.—September 24th. 695 yd. of feeder cable for the U.D.C. See "Official Notices" to-day.

Yarmouth.—The T.C. has instructed its electrical engineer to advertise for 2,000 tons of Derbyshire fine slack coal for the mechanical stokers. He was also authorised to order a quantity not exceeding 700 tons of Scotch anthracite nut coal at 9s. 3d. per ton from Messrs. W. Cory & Son, Ltd.

York.—September 24th. Traction switchboard for the Electricity Department. See "Official Notices" to-day.

CLOSED.

Admiralty.—We are informed that the British Electric Calibrated Fuse Co., of Harpenden, have received the Admiralty contract for all fuses, from 3 to 30 amps., required up to December 31st, 1911.

Australia.—According to a contemporary the P.M.G. has ordered telegraphic materials, &c., costing £983, from Messrs. Johnson & Phillips Ltd.

Belgium.—Five concerns submitted tenders for the supply and installation of the overhead equipment of the Trazegnies-Anderlues section of the new electric railway which is being built by the Société Nationale des Chemins de Fer Vicinaux, of Brussels. The lowest was that of Messrs. R. Henin & Co., of La Louviere.

La Société des Houilleres Unies, of Charleroi, has just placed a contract with a native concern for the installation of four electric winding engines at its collieries.

Bexhill.—The Corporation has accepted the tender of Mr. F. A. Greene, for £293, for pipework and valves for new condensing plant at the electric light works.

Bradford.—The T.C. has accepted the tender of Messrs. G. A. Steinthal & Boydell, Ltd., for motors for the conditioning house, at £209.

Burslem.—The Education Committee has accepted the tender of Messrs. Evans & Sons, Burslem, for installing the E.L. at Middleport Schools, at £86 15s.

Cheltenham.—The T.C. has accepted the tender of Messrs. Heenan & Froude for duplicating the refuse destructor, at £5,796.

Edmonton.—The order for 49 A.C. porthole fans for the Infirmary has been placed with Messrs. Hogan & Wardrop, of London, for their E.M.I. fans.

Portsmouth.—The Corporation Telephone Committee has accepted the tender of W. T. Henley's Telegraph Works Co., 1,500 yd. 24-pair cable, at £54. Other tenders were:—B. I. and H. Cables, Ltd., £56; Electrical Co., Ltd., £72; Western Electric Co., £76.

The E.L. Committee has accepted the tender of the British Wettinghouse Co. for six feeder panels, at £168. The firm of Siemens Bros quoted the same figure, and the other tenders were:—B.T.-H. Co., £341; Dick, Kerr & Co., Ltd., £342. The tender of the B. I. & H. Cables, Ltd., for two feeder pillars, at £59, was also accepted.

Stockport.—The Governors of the Infirmary have accepted the tender of Messrs. Turner & Atherton, of Stockport, for the erection of an electric hoist, and the fitting up of an X-rays equipment.

South America.—Messrs. James Gordon & Co. have received an order, from South America, for 1,200-H.P. water turbines with governors, and other accessories.

Swansea.—The E.L. Committee has accepted the following tenders:—

Arc lamps.—Veritys, Ltd.
Cables.—Callender's Cable and Construction Co.
Arc lamps, pillars, brackets, and raising and lowering gear.—The London Electric Firm, from £383 to £386, according to the type of raising gear best suited for use in conjunction with the arc lamps recommended.
Switch pillars and joint boxes.—Lucy & Co., Ltd.

Worthing.—The T.C. has accepted the tender of the Beck Flame Lamp Co., for Beck lamps, at £638.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Saturday, September 25th. At 3 p.m. Visit to the Imperial International Exhibition, Shepherd's Bush.

Municipal Tramways Association.—Wednesday, September 22nd, to Friday, September 24th. Annual Conference at the County Hall, Spring Gardens, London, S.W. See Elec. Rev., September 10th, page 425, for titles of papers.

The Electrical Propulsion of Ships.—Mr. W. P. Durtnall, whose proposals for the electrical propulsion of steamships are familiar to our readers, has issued a circular letter protesting against a letter published in the *Times* Engineering Supplement of September 8th, in which a leading member of the electrical profession deprecates the "extravagant claims made for electric propulsion." Mr. Durtnall's zeal and enthusiasm in the advocacy of this are well known, and no doubt, like all enthusiasts, he may paint too rosy a picture at times; but, still, it must not be supposed that his propaganda is not well founded. The writer of the *Times* letter himself—Mr. H. A. Mavor—is the inventor of a special system of electrical propulsion, which, we infer from his letter, is being applied to a ship of over 1,000 H.P., and he is a strong advocate of electrical driving.

In this connection it is interesting to note that the Institute of Marine Engineers has just awarded Mr. Durtnall the Denny Gold Medal for his paper on "The Generation and Electrical Transmission of Power for Main Marine Propulsion and Speed Regulation," read on July 18th, 1908, which was considered the best of the papers submitted in competition for the medal during the session 1908-9.

Will.—Estate valued at £10,331, with net personalty £3,253, was, according to the *Times*, left by the late Mr. G. Ellis, a director of the South London Electric Supply Corporation, Ltd.

NOTES.

The Science of Plant Management.—It has been an often repeated experience on the part of engineers connected with electricity supply undertakings that on approaching a possible consumer on the question of power he is confronted with the fact that the consumer has very little idea of the pros and cons of the question of private *versus* public supply, considered from an economic point of view. He is, for example, only too apt to put down a negligible amount for depreciation, and to ignore management and operating costs in running the plant. A comparison between station prices and private supply prices, therefore, becomes unfavourable to the former, and it requires a huge amount of persuasion to make the consumer see that such items are not fictitious values in the account. A development in the extension teaching course of the Columbia University, of New York, indicates, to a large extent, the line upon which such faulty reasoning will be best corrected, owing to the education of operating engineers, building superintendents, engineers' assistants and others, who have so much to say with regard to the plant requirements of any particular factory. A course has been arranged upon the subject of plant management, and is intended for engineers of the above description who already have a good knowledge of arithmetic and elementary physics. By the courtesy of the Columbia University, we are enabled to indicate the practical standpoint from which the problems of plant management are studied. Starting, first of all, with the problem of machinery selection, the layout and installation of plant is discussed. Schedules for the identification and operation of plant are then elaborated, and the common units for measuring plant economy, together with the instruments and methods of measurement, are treated.

A considerable section of the course is devoted to the subject of engine-room accounting. In this section it is shown how to construct records of operation and to compute results from the operating data. The systems for filing records for daily comparison and reference are explained, while the course includes the question of purchase of coal and supplies, payment of labour, store and tool room management, computation of total operating costs per unit output, the question of plant depreciation, interest, depreciation annuities, computation of actual cost per unit output, arrangement of expense and plant efficiency reports to owners.

The third important section of the course deals with cost analysis and expense control. In this the method of determining standard unit costs and the distribution of expense to the various systems operated is discussed, together with leakages and direct expenses in operation and machinery. The relation between plant efficiency and the actual cost per unit is also explained. An important, and perhaps novel, feature on this side of the Atlantic, is the section devoted to industrial betterment methods. There is no doubt that this, however, forms a very real factor in the efficient working of such plants. The training and handling of men, apprenticeship and bonus systems for power plants are examined, while the means and methods to be taken against accident including fire, underwriters' regulations and liability insurance, are discussed. The course finishes with fire protection and appliances, and fire fighting organisation for individual buildings.

The course extends over 40 lessons, taken twice a week for a period of 1½ hours each, and it will be seen that students who successfully graduate in a course of this description will have attained an intelligent idea, not only of the actual management of plant, but of the economic reasons which underlie the best methods of power plant management. It would be a distinct boon if such a course could be initiated on practical lines by colleges in this country for the benefit of those who do not yet understand the essential problems underlying the choice and management of power.

The Industrial Exhibition at Nancy.—Nancy is the centre of the great industrial region of France lying along the Belgian and German frontiers. The exhibition has been promoted by the financial and industrial interests of this district, whose products are fully represented; these form the greater part of the exhibits, but interesting examples are not wanting from the ends of France and from Germany and Switzerland.

The Metallurgical Hall is one of the most interesting, and impresses on the visitor that French iron and coal are important factors in European industry. There are reproductions of galleries in the ore mines, with examples of timbering and specimens of ore, castings, forgings and rolled products.

Passing through a 24-ft. stator (by the Société Alsacienne de Constructions Mecaniques), one reaches the engine room, where are installed three large low-speed reciprocating sets of 600 to 1,000 H.P., 90-100 R.P.M., showing many points of interest in the valve-gear, &c. The large stator referred to above is for 1,900 KW., three-phase, 550 volts, 50 cycles, 94 R.P.M. Turbine practice is represented by two turbo-generators of 750 KW. by the Cie. Générale Electrique, of Nancy, and by the Société Alsacienne; the latter (a Zoelly turbine) runs at 3,000 R.P.M., 50 cycles, generates at 5,000-5,500 volts, and is connected through a step-down transformer in parallel with the low-speed sets to a system of aluminium mains by the Société Electro-Métallurgique Française. The engine room is served by a battery of boilers of the Mathot Stoft and Garbe types.

There are further exhibits of turbines by Schneider, of the famous Creusot works (Brown-Boveri-Parsons type) and by the Rateau Co.

One of the most interesting exhibits in this section is a pair of compound engines with superheating arrangements between boiler and H.P. cylinder, and between H.P. and L.P. cylinder. The superheat can be arranged so that the steam is dry at the end of each expansion without excessive superheating between boiler and H.P. cylinder. These engines are installed by Heinrich Lanz & Co., of Mannheim, and are on the Lentz system.

There is not a single exhibit of the high-speed reciprocating type so much favoured in this country.

In the electrical section the exhibit of the Société Alsacienne makes the best display. A repulsion motor (50 H.P., 350 volts, 25 cycles, 500 R.P.M.), one of 80 for the Railways of the "Sud," may be contrasted with a D.C. traction motor of the same output. The repulsion motor is 40 per cent. larger than the D.C. machine.

A vertical booster by the same company occupies about half the floor space required for a horizontal position. A green glass insulator by a firm whose speciality is champagne bottles attracts notice by the high voltage—100,000 volts—it is designed for. Fabius Henrion, of Nancy, shows an extensive range of electrical machinery, and there are many interesting examples of standard apparatus by various firms, which cannot here be described in detail, but which well merit examination. In the textile section is exhibited a single-phase commutator motor of variable speed for cotton machinery by Messrs. Brown, Boveri. The textile department itself is large and important.

Mention, at least, must be made of the fine exhibit of rolling stock and locomotives, one of the latter with a water-tube boiler. There is the usual array of lighter attractions and dissipations. The whole of the exhibits are housed in graceful white buildings. The Exhibition closes next month.

Electricity in Mines: Questions in the House.—In the House of Commons, on September 15th, Mr. Markham asked the Secretary of State for the Home Department what was the definition of a completely-enclosed motor in the Home Office rules relating to electricity in mines, and whether a flame-proof motor not totally enclosed was covered by the definition completely enclosed? Mr. Gladstone replied: I am advised that the enclosed required by Special Rule 37 is total enclosure, and this, I understand, is the view generally taken in the industry. The case of a "flame-proof motor not totally enclosed" would not, therefore, be a compliance with the rule; but the point has been noticed for reference to the committee on the rules which I am about to appoint. Mr. Markham: Is the right hon. gentleman aware that a member of the committee which drew up these rules stated that "completely enclosed" meant nothing to the mind of the Commissioners more than "totally enclosed"? Mr. W. E. Harvey: In view of the loss of life which has occurred recently in mines, and which is attributed to electricity, I wish to know if the Government are prepared to undertake some experiments with regard to electricity in mines. Mr. Gladstone: As I have already stated, I am about to appoint a committee, and it is extremely probable that the committee will extend its inquiries to this question.

Alleged Nuisance from a L.C.C. Sub-station.—Sir William Collins, in the Parliamentary Papers, last Friday, asked the President of the Board of Trade whether his attention had been directed to complaints made of nuisance arising by noise and otherwise from the working of an electric sub-station of the L.C.C. in Arlington Road, St. Pancras; whether the station had been inspected on behalf of the Board of Trade; whether the working of the station was in accordance with the Board of Trade regulations; and whether the Board had suggested, or would suggest, any action with a view to abating the nuisance complained of. In reply, Mr. Churchill says:—The sub-station in question has not been inspected on behalf of the Board of Trade, and is not liable to such inspection, nor is its working subject to the Board of Trade regulations. He has, however, asked the L.C.C. for their observations on the nuisance stated to exist and will communicate their reply to his hon. friend.

Strange Fatality.—It is reported from Gillingham, Dorset, that a boy named Harry Andrews, aged 9, met with his death from paralysis set up by a current of electricity from a toy magnetic battery. The instrument, which is about the size of a matchbox, and is sold for about 2s., belonged to another lad who, while bathing, left it with his clothes on the river bank. Andrews took hold of the battery and received a shock, which he told his father later "seemed to shift all the bones in his body." Symptoms of paralysis set in, and a doctor was called, but the lad gradually got worse and died. Dr. Walker was of opinion that the current set up neuritis, which gradually spread to the spinal cord and brain. Deceased was not a robust boy.—The jury found that death was caused by paralysis produced by the electric current from the battery which deceased handled by misadventure.

Westminster Electric Swimming Club.—The members of the above Club held their ½-mile championship race at Thames Ditton on Saturday last, September 11th. The event was somewhat marred by the exceptional coldness of the water, but the conditions overhead were perfect. The race ended in a victory for S. G. Taylor (mains department), W. Llewhellin (drawing office) being second, and the others finishing in the following order:—3, A. E. Watson; 4, R. Litt; 5, S. A. Crowe; 6, F. Dodd; 7, E. L. Stern. Three competitors, F. R. Crump, W. Hurman and A. Collingwood were overcome by the coldness of the water, and had to give up, the last-named being only a few yards from home. Tea was afterwards partaken of at the Albany Hotel, and the afternoon sport was voted a great success.

Life in China.—We have received an inquiry as to the cost of living in Shanghai. While we have published articles on the cost of living in many foreign countries, we have not dealt with China, and we should be glad to hear from any readers who have had experience of life in this country.

Electrical Contracts for the Navy.—On Tuesday, in the House of Commons, Mr. Renwick asked the First Lord of the Admiralty whether, in the case of contracts which had recently been placed for the electric light installations and searchlights in British warships now building, the contractors for such installations, &c., being British branches of German firms, it was made a condition of the contract that only British-made cables, machinery, and fittings should be used, and only British subjects employed in the superintendence and fitting of same on board the vessels; and whether precautions had been taken to prevent the necessary plans of the ships supplied to the contractors being sent abroad or shown to foreigners. Mr. McKenna, in reply, said that in a contract of the kind it was made a condition that only British-made cables, machinery, and fittings should be used, and only British subjects employed in the superintendence and fitting of them on board the ships. With regard to the last part of the question, the following provision had been embodied in recent contracts:—"This contract involves an obligation of secrecy within the meaning of Sec. 2 of the Official Secrets Act, 1889. The contractors shall at their own expense take all such measures and precautions to ensure secrecy in connection with the design, construction, equipment, and completion of the said vessel as may be necessary, including therein all such measures and precautions as may be regarded as necessary by the Commissioners, and the contractors shall if so required at any time by the Commissioners, afford to them such evidence as the Commissioners may consider satisfactory that all such measures and precautions have been, are being, and will be taken." In reply to a further question, Mr. McKenna said that the conditions were strictly carried out.

Copper.—In its issue of September 3rd the *Financier* has an article, in which it is anticipated that the current year will be close on 1906 in total copper deliveries, indicating a considerable revival in consumption. While taking into account the fact that consumers have been waiting for the market while stocks have been accumulating, there seem indications of a trade revival in this country, which, coinciding with that in the States, must result in a large demand.

Educational Notes.—UNIVERSITY OF LONDON.—An "Appointments Board" has been constituted by the University of London, to assist graduates and students of the University in obtaining employment, and to assist employers to find, in the University ranks, suitable men for vacancies. Those who know of vacant appointments suitable for University men are invited to communicate with the Secretary of the Board.

POLYTECHNIC SCHOOL OF ENGINEERING, Regent Street, W.—The new session commences on the 27th inst. We have received the syllabuses of the engineering courses, which include, besides the usual subjects, motor-car and "aero" engineering. Mr. W. Hibbert is the head of the electrical and physics department. A special course of lectures on medical electricity will commence early in October.

INTERNATIONAL CORRESPONDENCE SCHOOLS.—To-morrow (Saturday) a reception is to be held at the headquarters of the "I.C.S.," Kingsway, to which all British students of the schools are invited by the directorate, and in the evening there will be a banquet at the Hotel Cecil, at which the Rt. Hon. Lord Montagu of Beaulieu will preside, supported by representatives of several of the engineering societies and other eminent personages. Besides the 50 branches of the I.C.S. in the United Kingdom, there are branches in all the British Colonies and Dependencies, from which representatives have been invited, and it is anticipated that the function will mark an epoch in the history of the I.C.S.

Appointments Vacant.—Assistant engineer and carshed foreman for the Sunderland District Electric Tramways, Ltd. (£2). Instructor in electrical and mechanical engineering for the Limerick Municipal Technical Schools (£130). See our advertisement pages for particulars.

Institution and Lecture Notes.—INSTITUTE OF METALS.—At the Autumn meeting, which will be held at Manchester on October 14th and 15th, it is expected that the following papers will be presented:—

J. H. Andrew, M.Sc., and C. A. Edwards, on "The Constitution and Properties of the Ternary Alloys Aluminium-Copper-Tin."

C. O. Bannister, Assoc.R.S.M., and H. J. Tabor, on "The Surface Appearance of Solders."

H. W. Greenwood, on "The Technical Assay of Zinc."

J. S. Glen Primrose, on "Notes on the Production of Pure Spelter."

E. L. Rhead, on "Some Causes of the Corrosion of Copper and Brass."

Prof. C. A. Smith, M.Sc., on "The Elastic Breakdown of Ductile Materials."

Prof. T. Turner, M.Sc., and M. T. Murray, M.Sc., on "The Copper-Zinc Alloys—A Study of Volume Changes during Solidification."

Applications for membership of the Institute, to permit of election prior to the Manchester meeting, should be sent in to the secretary, Mr. G. Shaw Scott, M.Sc., Caxton House, Westminster, S.W., on or before Saturday, September 25th.

SOCIETY OF ENGINEERS.—This year's prize for the best essay on "How to Improve the Status of Engineers and Engineering, with Special Reference to Consulting Engineers," has been awarded to Mr. G. Allan Thomas, M.C.M.E.S., who will read his essay at the meeting to be held on October 4th at 7.30 p.m. at Caxton Hall, Westminster.

Developments on the Thury D.C. System.—We are informed that the well-known series direct-current transmission line from Moutiers to Lyons, which has been in operation since 1905, has proved such a remarkable success that very important developments are to be carried out on the same lines.

The generating station itself is situated near Moutiers (Savoy), and takes its power from the River Isere; it was fully described in our issue of August 10th, 1906. The total power of the D.C. high-pressure plant at present is 6,400 H.P.; energy is transmitted at a pressure of 57,600 volts to Lyons, a distance of 180 kilometres, by means of two conductors of 9 mm. diameter. Parallel to the D.C. line is a three-phase line going to the same point. At Lyons the D.C. energy is utilised in driving a number of motor-generators.

The series system has not only demonstrated its elasticity, but has proved to be so reliable and easy to operate that the companies concerned have decided immediately to carry out extensions on a large scale.

A generating station is to be erected at La Bridoire (Savoy), in which three high-pressure D.C. sets will be installed, each of 2,000 H.P. at 428 R.P.M.; they will generate a current of 150 amperes at a pressure of 8,000-9,125 volts.

A second generating station on the Roziers at Bogel (Savoy) will contain two generating groups, each consisting of two double machines driven by the same turbine and capable of giving an output of 3,500-4,000 H.P. at 428 R.P.M., and delivering a current of 150 amperes at 16,000-18,250 volts. A corresponding amount of D.C. motor-generator plant will be placed in the Vaulx-en-Velin sub-station.

The total capacity of the direct-current high-pressure generating plant, when the extensions are complete, will be 15,000 KW., and the three generating stations connected in series will deliver 150 amperes at 100,000 volts. This will be a noteworthy development, as for the first time in Europe an operating voltage of 100,000 volts will be reached, and it is claimed that this pressure is not the limit which can be achieved on this system.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Weymouth T.C. has increased the salary of MR. J. H. BOLAM, electrical engineer, to £250 per annum as from March 31st last, rising by £25 a year to £300.

The Luton T.C. has increased the salary of MR. W. H. COOKE, electrical engineer, from £350 to £400 per annum.

The Llandilo T.C. has appointed MR. BOWEN, of Llandilo, as electrical engineer.

We understand that MR. BARNARD, the electrical engineer of Walsall, who has been ill for over a month, is now making satisfactory progress towards recovery.

The Bristol Electrical Committee has recommended the appointment of MR A. E. WILSON, the present distributing superintendent, as deputy city electrical engineer, at a salary of £300 per annum, rising by £25 a year to £400.

MR. W. B. MORGAN, station superintendent at Avonbank, Bristol, has resigned, and is proceeding to take up an appointment at Dawson City.

Tramway Officials.—The staff and employés of the Huddersfield Tramways have presented a Sheraton inlaid timepiece to MR. FRANK SMITH, station engineer, on his marriage.

General.—PROF. S. P. THOMPSON, D.Sc., F.R.S., has consented to become the first president of the Illuminating Engineering Society.

MR. J. H. RITCHIE, who wrote the interesting "Notes on Life in Western Australia" which appeared in our last issue, and which were based upon his 13 years' experience of that part of the world—4½ years being spent as electrical engineer on the Lake View Consols—is now staying in London for a short time. He will go abroad again as soon as he has fixed up an appointment.

In July last a complimentary smoking concert was held at Wellington, New Zealand, in honour of MR. J. K. LOGAN, I.S.O., to congratulate him upon the honour conferred upon him by His Majesty the King, in appointing him a Companion of the Imperial Service Order, nearly 150 officers of the Telegraph and Postal Service being present, with Mr. Hutton, the chief Postmaster, in the chair. The toast, "Our Guest," was proposed by Mr. T. Buckley, Electrician, who referred to Mr. Logan's experiences in the early days of New Zealand telegraphy, and his guidance in keeping the Department up-to-date as telegraphic science advanced. Mr. Logan has had to do with almost every extension of the telegraph line in the Dominion, and for 17 years he has filled the office of Superintendent of Electric Lines. In responding, Mr. Logan said that he was associated with the Department in the early days, having arrived in Dunedin in 1864, and he proceeded to indulge in some very interesting reminiscences of his connection with telegraph and telephone construction and development in New Zealand from that date down to last year, when there were 1,763 offices—296 telegraph and 1,468 telephone—in operation. He regarded the distinction now conferred upon him as a compliment to the Post and Telegraph Department.

NEW COMPANIES REGISTERED.

National Electric Signs Co., Ltd. (7,267).—This company was registered in Edinburgh on September 8th, with a capital of £3,000 in £1 shares, to acquire the rights to erect and use in Great Britain the German invention "Universal Licht-Reklame," and to carry on in the United Kingdom or elsewhere the business of general advertisers and contractors. The subscribers (with 25 shares each) are:—F. Land, 73, Robertson Street, Glasgow, iron merchant; J. Barr, 67, Hope Street, Glasgow, coal exporter; D. Graham, 180, Hope Street, Glasgow, house factor; J. Mackenzie, 67, West End Park Street, Glasgow, electrical engineer; J. Stewart, 67, Cadder Street, Pollokshields, engineer; A. Braithwaite, 67, Hope Street, Glasgow, clerk; J. B. Ramsay, 118, Bath Street, Glasgow, writer. The number of directors is not to be less than three or more than five; the first are F. Land, J. Barr and D. Graham; qualification, £25; remuneration as fixed by the company. Registered office, 112, Bath Street, Glasgow.

International Filaments, Ltd. (104,923).—This company was registered on September 11th, with a capital of £20,000 in £1 shares, to acquire from Sir John W. Ottley, C. F. Call, H. Reynolds, J. Metcalfe, W. Stewart and M. Gregory, foreign and colonial rights and secret processes and inventions relating to the manufacture of metal filaments and electric incandescent lamps, and to carry on the business of electric, telegraph, telephone, mechanical and consulting engineers, manufacturers of and dealers in electric incandescent lamps and filaments, &c. The subscribers (with one share each) are:—A. C. Vincent, 34-6, Gresham Street, E.C., incorporated accountant; R. C. J. Goodrich, 34-6, Gresham Street, E.C., chartered accountant; F. S. Eaton, 34-6, Gresham Street, E.C., clerk; A. J. Needham, 18, Midland Terrace, Cricklewood, N.W., clerk. Private company. The number of directors is not to be less than two or more than five: the first are W. Stewart and J. Metcalfe; qualification, 100 shares; remuneration as fixed by the company. Registered office, 34-6, Gresham Street, E.C.

Electrical Trolley Head Co., Ltd. (104,886).—This company was registered on September 8th, with a capital of £6,000 in £1 shares, to adopt an agreement with J. T. Cherry and E. H. Clive for the acquisition of certain patents, and to carry on the business of electrical engineers, manufacturers of, and dealers in, electrical trolley heads, &c. The subscribers are:—L. James, 7, Argaum Villas, Devonport, accountant, 10 shares; S. J. M. Hocking, 103, Fore Street, Devonport, confectioner, 1 share; S. J. Harris, 4, Alma Place, Plymouth, jeweller, 10 shares; S. G. Pearce, 28, Caroline Place, Stonehouse, Devon, engineer, 5 shares; S. Sampson, Waterloo Street, Plymouth, grocer, 1 share; E. Browning, North Hill Pharmacy, Plymouth, chemist, 1 share; T. Lloyd, Westbury House, Beach Road, Emsworth, Hants., 1 share. Minimum cash subscription 1,000 shares. The number of directors is not to be less than two or more than seven; the first are S. J. Harris and J. Griffin; qualification, 10 ordinary shares.

Dioptric Sign Co., Ltd. (104,860).—This company was registered on September 6th, with a capital of £1,000 in £1 shares (250 cumulative preferred, 500 ordinary, 250 deferred), to acquire from E. L. Warren the benefit of certain existing inventions relating to an improved sign, to develop and turn to account the same, and to carry on the business of electrical engineers, metal workers, shop fitters, gas fitters, &c. The subscribers are:—A. H. Chalmers, 5, Fenwick Street, Liverpool, chartered accountant, 25 shares; A. G. Brigley, 54, Ferndale Road, Sefton Park, Liverpool, book-keeper, 10 shares; J. W. Towers, Widnes, Lancs., chemical manufacturer, 50 shares; J. O. Rhodes, 139, Duke Street, Liverpool, electrical engineer, 15 shares; Turner & Dunnett, 19, Fenwick Street, Liverpool, printers and stationers, 150 shares. Private company. The first directors are not named. Registered by T. T. Hull & Son, 22, Chancery Lane, W.C.

R. Lascelles & Co., Ltd. (104,853).—This company was registered on September 4th, with a capital of £1,000 in £1 shares, to adopt an agreement with R. Lascelles and to carry on the business of mechanical, electrical and general engineers, manufacturers of and dealers in electric, magnetic, telephonic and other apparatus, &c. The subscribers (with one share each) are:—T. Figg, South Fambridge, Essex, engineer; A. F. Kemp, 7, Carlisle Street, Oxford Street, W., engineer; A. H. Kirkaldy, Harlow, Essex, engineer; R. Lascelles, 55, Hans Road, S.W., engineer. Private company. The number of directors is not to be less than two or more than five; the first are R. Lascelles and T. Figg; qualification, one share; remuneration as fixed by the company. Registered by Seton, Cardew & Co., 9, Southampton Street, Bloomsbury Square, W.C.

OFFICIAL OF RETURNS ELECTRICAL COMPANIES.

Underground Electric Railways Co. of London, Ltd. (73,376).—Particulars of £1,000,000 debentures created August 12th, 1909, and secured by trust deed of even date, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: Generating station at Chelsea, benefit of certain contracts, &c. Trustees: J. Trotter, H. Cockburn and J. A. Dawes.

"Z" Electric Lamp Manufacturing Co., Ltd. (96,594).—Particulars of £25,000 debentures, created August 13th, 1909, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Lepel Wireless Syndicate, Ltd. (101,881).—Charge dated August 13th, 1909, to secure £200, charged on proceeds to be received from the Government in respect of the first two stations which the syndicate is delivering to the Admiralty. Holder: Sir Thomas Myles, Kt., Madresfield Court, Malvern.

Electrolytic Alkali Co., Ltd. (64,360).—Issue on August 16th of £3,700 debentures, part of a series of which particulars have already been filed.

Lodge-Muirhead Wireless and General Telegraphing Syndicate, Ltd. (70,881).—Particulars of £10,000 debentures created August 20th, 1909, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £7,600. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Church Stretton Electric Supply Co., Ltd. (80,857).—Charge dated August 28th, 1909, to secure £100 (supplemental to a charge dated March 17th, 1909). Property charged: Certain land at Church Stretton, Salop, with the generating works and other erections thereon, and a Provisional Order relating to the Urban District of Church Stretton and Parishes of All Stretton and Little Stretton assigned to the company under an Assignment dated May 18th, 1904, by Church Stretton, Ltd. Holder: E. Bond, 48, Thurloe Square, London.

British Aluminium Co., Ltd. (41,104).—Two mortgages dated August 20th, 1909, to secure £73,930 19s. 10d. each (supplemental to indentures dated July 17th, 1909). Property charged: The company's undertaking and property, present and future, including uncalled capital. Holders: Wernher, Beit & Co., 1, London Wall Buildings, E.C.; and W. Morrison, H. Morrison and J. A. Morrison, 53, Coleman Street, E.C.

Regent Electric Co., Ltd. (100,189).—Particulars of £100 debentures created August 20th, 1909, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £75. Property charged: The company's property, present and future, including uncalled capital. No trustees.

CITY NOTES.

Dumbarton Burgh and County Tramways.

At the annual meeting, Major Heaton-Ellis, in moving the adoption of the report (see Electrical Review, September 3rd, page 390), pointed out that this was the first complete year of the company's operations, and that the total revenue amounted to £19,495. This was particularly gratifying in view of the fact that during a considerable part of the year the weather was very disappointing. The proceeds of the issue of the debenture stock had been sufficient to meet the balance of the construction contract, and the whole capital expenditure had not exceeded what the directors originally estimated for; in fact, there was a balance in capital account to their credit. Turning to the trade conditions, he said they could hardly expect to experience a more depressed state than that which prevailed during the past year, but he hoped, and was led to believe, that the depression which had been so marked during the last year was gradually lifting, and that the trade on the Clyde, and in the district served by the tramways, appeared to be improving. Their system would, of course, benefit substantially with improved trade and the consequent development of the route. Meantime it was a matter of satisfaction to know that in a period when trade was stagnant and weather conditions were unfavourable they were able, after providing for interest on debenture stock and the full dividend on the preference shares, to carry forward the substantial sum of £3,000. The report was adopted.

Poole and District Electric Traction Co., Ltd.

The report of the liquidators states (according to the *Financier*) that the liquidation of the company was commenced in July, 1905, but owing to the delay occasioned by the litigation with the Bournemouth Corporation, full particulars of which have been from time to time given to the shareholders, the liquidators have been unable until this date to convene the final meeting. The total proceeds from the realisation of the assets amount to £137,880, and the disbursements to £136,600, which latter amount makes, with the final distribution of £3 3s. per share, a total return to the shareholders of £19 3s. in respect of each £10 share held by them. The balance, amounting to £1,280, has been retained by the Board of Trade. Of this amount, £30 is to meet outstanding dividend warrents, and £1,250 is reserved as remuneration of the liquidators, including office accommodation and services provided by the British Electric Traction Co. during the four years over which the liquidation has extended, and also a contingent claim of £158 for legal costs. Resolutions will be submitted at the meeting to authorise the payment of £1,250 to the liquidators, and to authorise the liquidators to hand the books and papers of the company to the British Electric Traction Co. to be dealt with as that company in its discretion may decide.

British Thomson-Houston Co., Ltd.

The fourteenth ordinary general meeting of the shareholders of the above company was held on Tuesday at the offices, 83, Cannon Street, Mr. G. Franklin presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, September 10th, page 427), said that the directors had taken the somewhat unusual course in industrial companies in making their report a pretty full one, dealing with the various branches of the company's business, and the accounts showed the results which had been arrived at by the year's trading. He therefore did not propose to enlarge upon the report or accounts, unless any shareholder desired to ask for any information.

Mr. H. C. Lewis seconded the motion, and the report was adopted without discussion.

Continental.—Russia.—The Russische Gesellschaft Schuckert & Co., of St. Petersburg, reports a net profit of 102,742 roubles for the last financial year. A dividend of 3 per cent. is being declared, the same as for the preceding 12 months.

Belgium.—A new company has recently been formed in Brussels with a capital of £11,000 and the title La Société Industrielle Electrique Belge.

La Société Belge des Lampes Electriques, of Ixelles, is increasing its capital to £10,400.

James Keith & Blackman Co., Ltd.—A dividend of 5½ per cent. (1s. 1½d. per share) on the preference shares is announced for the year, with £2,301 carried forward.

Shawinigan Water and Power Co.—A dividend o 1 per cent. for the quarter to 30th inst. is announced.

MARKET QUOTATIONS.

Wednesday, September 15th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	„	28/-	..
a „ Sulphuric	„	5/6	..
a Ammoniac, Sal	„	42/-	..
a Ammonia, Muriate (crystal)	per ton	£29	..
a „ „	„	£30	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon	„	£12	..
a Copper Sulphate	„	£18 10	..
a Lead, Nitrate	„	£26 10	..
a „ White Sugar	„	£23 10	..
a „ Peroxide	„	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a „ Chlorate	per lb.	8½d.	..
a „ Perchlorate	„	9⅜d.	..
a Potassium, Cyanide	„	7d.	..
a Shellac	per cwt.	75/-	1/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	„	£6 10	..
„ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70 %)	„	£10 15	..
a „ Chlorate	per lb.	8⅜d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	9d.	..
a „ Cyanide (basis 100 %)	„	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£80	..
b „ Wire, in ton lots	„	£112	..
b „ Sheet, in ton lots	„	£120	..
p Babbitt's metal ingots	„	£50 to £136	..
c Brass (rolled metal 2" to 12" basis)	per lb.	7¼d.	¼d. dec.
c „ Tube (brazed)	„	8d.	¼d. dec.
c „ „ (solid drawn)	„	7d.	¼d. dec.
c „ Wire, basis	„	6¾d.	¼d. dec.
c Copper Tubes (brazed)	„	8⅝d.	⅛d. dec.
c „ „ (solid drawn	„	8⅜d.	⅛d. dec.
g „ Bars (best selected)	per ton	£71	£1 dec.
g „ Sheet	„	£71	£1 dec.
g „ Rod	„	£71	£1 dec.
e „ (Electrolytic) Bars	„	£60 10	£1 dec.
e „ „ Sheets	„	£77	£1 dec.
e „ „ Rod	„	£65 10	10/- dec.
c „ „ H.C. Wire	per lb.	7¼d.	¼d. dec.
f Ebonite Rod	„	8/3	..
f „ Sheet	„	8/-	..
n German Silver Wire	„	1/6	..
h Gutta-percha, fine	„	5/6 to 6/6	..
h India-rubber, Para fine	„	8/5	3d. inc.
j Iron Pig (Cleveland warrants)	per ton	51/-	4½d. dec.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Ingot	„	£18 to £18 2 6	5/- inc.
m Manganin Wire No. 28	per lb.	6/6	..
q Mercury	per bot.	£8 7 6	2/6 inc.
d Mica (in original cases) small	per lb.	6d. to 1s.	..
d „ „ „ medium	„	2/6 to 4/-	..
d „ „ „ large	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	1/- to 1/1½	..
p „ „ rolled bars & rods	„	1/1½ to 1/3	..
p „ „ rolled strip & sheet	„	1/2½ to 1/6	..
o Platinum	per oz.	105/-	variable.
e Silicium Bronze Wire	per lb.	9d.	½d. dec.
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£134 10 to £135 10	£2 10 dec.
n „ Wire, Nos. 1 to 16	per lb.	1/9	..
p White Anti-friction Metals:—			
"White Ant" brand	per ton	£35 to £60	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	£26	10/- inc.

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
j Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Dundee and Broughty Ferry Tramway Co., Ltd.—At the annual meeting of this company, ex-Provost Brownlee, in moving the adoption of the report, said the drawings had increased by £170, and the working expenses were £70 down. Their line was very much a fair-weather line, and it was some consolation to know that last year was not a very favourable one for their business. While the directors had resolved to pay the usual dividend on the preference shares, they did not see their way clear to pay a dividend on the ordinary shares. When the time came, they must be prepared to reconstruct the permanent way out of revenue. The report was adopted.

Bromley (Kent) Electric Light and Power Co., Ltd.—The directors have declared an interim dividend of 4 per cent. per annum (2s. per share), less income-tax, on the ordinary shares for the past half-year.

Winnipeg Electric Railway Co.—A dividend of 2½ per cent. for the quarter ending 30th inst is announced.

STOCKS AND SHARES.

Tuesday Afternoon.

The process of revivifying business is always a slow affair, and it must be confessed that the present September has lived up to its usual reputation in this respect. High-class securities are just a trifle scared by the prospect of money becoming slightly dearer as the autumn advances, and the crop requirements of the world require to be financed. There is, however, no danger of money getting dear for some time to come.

The death of the well-known American railroad magnate, Mr. P. H. Harriman, which caused a mild sensation in financial circles, has acted upon electrical markets only to the extent of strengthening some of the cable companies' shares.

There are intermittent sparkles of activity in the Home Railway market, but they seldom last for more than an hour at a time—if for so long as that. The Board of Trade Returns for August indicate that the recovery in trade continues, but this factor goes for little in the Railway department, when prices are, as Lord Rosebery might truly say, in the melting-pot. Central Londons are amongst the firmest of the electrical issues. Great Northern, Piccadilly and Brompton Preference rose to 8¼ the other day—a movement all the more noticeable on that occasion from being the only exception to a dismal list of declines in other Home Rails.

Baker Street and Waterloo can no longer be bought at par. Charing Cross, Euston and Hampstead Debenture has primed up to 95, and Great Northern Debenture is steady at 97.

Underground Electric Railway of London descriptions are moving rather irregularly. Business in the Income bonds was marked at 36 the other day. The 5 per cent. prior lien bonds are 103; the 4½ per cents. at 89, with three months' interest accrued, can be picked up to pay a trifle over 5 per cent. on the money.

News from Mexico is of a conflicting character, and it is very difficult to sift the contradictory evidence, to understand whether the country is really prospering or whether it is but the hot-bed of revolutionary reaction whose early outbreak is inevitable. Prices of the Mexican traction and power varieties are, however, well maintained on the whole, moving within narrower margins than the market has of late been accustomed to. Mexico Trams are nearly 130, and the Power Company's Common shares stand about 72. Monterey Debenture holds its improvement at 90. Of the others in the same group, but outside Mexico, business in Rio Trams is being done on the basis of 90½ to 92½, while Sao Paulo's keep about 148¼. There is not much change in the Anglo-Argentine Tramways or the British Columbia Electric Railway issues. There was an eager rush of proprietors in the latter concern to secure the new stocks just offered.

British Electric Traction Ordinary shares, it is of interest to notice, marked 13s. 9d. at the end of last week, and on the same day London United Preference changed hands at 50s. More London United shares could doubtless be bought at the same price.

The traffic accruing to the Anglo-American Cable Companies is declared to be the heaviest which those undertakings have enjoyed for several years, and the various stocks and shares are in demand. Of these, the 6 per cent. Preferred stock of the Anglo-American Telegraph Company looks reasonably attractive at 104¼. Dividends are payable quarterly; there is one due at the end of this month. Barring unexpected accidents, the full dividend looks safe for, at any rate, a year or two; and with the Deferred in the ranks of the popular gambling-counters at the present time, the Preferred might easily improve several points.

Eastern and Western Telegraph stocks and shares are firm. The Globe Company has declared its usual quarterly interim dividends.

Marconi shares gained another small fraction upon consideration of the Government being about to take over ship-to-shore stations. United River Plate Telephones are firm, but Monte Video Telephones can be bought at 15s. National Telephone Deferred is changing hands fairly freely in the neighbourhood of 122.

Electric Lighting shares are steady as featureless. Manufacturing issues are decidedly firm, and those of the armament companies have advanced substantially. The little rubber market has fresh prospectuses thrust upon it several days a week, and, in spite of all the criticisms directed at the prospects when competition shall have reduced the price of rubber to more normal values, quotations of the better-known shares are mostly strong.

South Metropolitan Electric Light and Power Co., Ltd.—The debenture stock register and register of transfers will be closed from September 17th to 30th, 1909, (both days inclusive) for preparation of warrants for interest at the rate of 4½ per cent. per annum, payable October 1st, 1909, for the half-year ended that date.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1905.	1906.	1907.	1908.	Closing Quotations Sept. 7th.	Closing Quotations Sept. 14th.	Business done week ended Sept. 14th, 1909. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2⅞ — 3⅛	2⅞ — 3⅛	..	..	..	Nil.
186,700	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	5 %	5 %	5 %	5 %	93 — 96	93 — 96	..	..	..	5 4 2
$181,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7½%	8 %	8 %	8 %	144 —146	145 —147	..	..	..	5 8 10
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	97 — 99	96 — 98	..	..	..	4 1 8
558,460	Anglo-American Telegraph	Stock	3½%	3½%	3½%	£3 4s.	60½ — 62½	61 — 63	..	..	+ ½	5 2 8
3,220,770	Do. do. do. 5 % Pref.	Stock	6 %	6 %	6 %	6 %	103½—104½	104 —105	104½	103½	+ ½	5 14 3
3,220,770	Do. do. do. Deferred	Stock	1½%	12½%	1 %	8/-	20½ — 20⅞	21½ — 21¾	21 3/16	20⅛	+ ⅛	1 17 3
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	103½—105½	101 —103	..	..	—2½	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	8 — 8⅛	8 — 8⅛	..	..	..	4 14 1
2,431,350	Commercial Cable, Stlng. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	90 — 92	90 — 92	91½	..	..	4 7 0
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	8½ — 9	8½ — 9½	..	..	+ ½	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 — 18	17 — 18	..	..	..	5 11 1
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	2⅞ — 3⅛	3 — 3½	..	..	+ ⅛	5 14 8
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅜ — 8¾	8½ — 8⅝	..	..	— ⅛	5 15 11
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —102	100 —104	..	..	..	2 4 2
60,710	Direct United States Cable	20	4½%	4⅝%	4½%	4½%	13 — 13½	13 — 13½	13⅛	13	..	6 5 11
43,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	128 —131	129 —132	130½	129½	..	5 6 10
2,000,000	Do. 5½ % Pref. Stock	100	5½%	5½%	5½%	5½%	84½— 86½	84½— 86½	86½	83½	..	4 0 0
1,496,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	104½—106½	104½—106½	105½	105	..	3 15 2
900,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	7 %	11½ — 12½	11½ — 12½	12⅛	11⅞	..	5 14 3
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..	3 16 11
200,000	East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	5⅝%	10½— 10⅝	10½— 10⅝	10½	10 7/16	..	5 7 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13½— 14½	13½— 14½	14	..	..	4 4 3
150,000	Great Northern Telegraph, of Copenhagen	10	24%	30 %	20 %	18 %	26 — 27	26 — 27	..	..	..	e 13 4
3,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	18 %	51½ — 53½	51½ — 53½	53	52½	..	6 1 6
$41,880,400	Mackay Companies Common	$100	2 %	3½%	4 %	4 %	83 — 86	84 — 86	..	..	..	4 18 0
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	74 — 79	74 — 78	..	..	..	5 2 0
994,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	3/32 — 7/32	3/32 — 7/32	16/6	16/-	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	5 %	6 %	6 %	6 %	1/32 — 1/16	1/32 — 1/16	12/6	..	— ⅛	6 17 2
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	3/32 — 1/16	3/32 — 1/16	..	..	— ⅛	5 14 3
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —107½	106 —107½	107½	106½	..	5 11 7
3,725,000	Do. do. Def. Stock	100	5 %	5 %	6 %	6 %	121½—123½	121 —123	122	121⅜	— ⅛	4 17 2
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10⅜ — 10¾	10⅜ — 10⅞	10 15/16	10½	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅜ — 10¾	10⅜ — 10⅞	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 7/16 — 5½	5 7/16 — 5½	..	..	..	4 7 3
2 000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	99½	98½	..	3 10 0
1,983,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
179,818	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	7 %	8 %	8 %	1⅜ — 1½	1 13/16 — 1 15/16	..	..	+ 1/32	5 6 1
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1¼ — 1⅜	1 7/8 — 1 29/32	..	..	+ 1/32	4 15 3
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	86¾	86⅜	..	4 14 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 16 5
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7⅞ — 8¼	7⅞ — 8¼	..	..	+ ⅛	4 17 7
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..	4 7 10
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	130 —133	130 —133	131	..	..	4 10 11
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6¾ — 7¼	6¾ — 7	7	6¾	— ⅛	5 14 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	..	..	..	4 8 10
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	2½%	4 %	..	1 3/16 — 1 5/16	1¼ — 1½	28/1½	..	+ ⅛	4 8 11
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	101 —108	100 —102	..	..	..	4 8 11
307,980	Western Telegraph, Ltd., Nos. 1 to 307,980.. ..	10	7 %	7 %	7 %	..	18½ — 19⅜	18½ — 18⅝	..	..	..	3 17 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	..	..	..	5 1 10
88,331	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	3/16 — 1/8	3/16 — 1/8	13/9	11/3	+ 1/16	3 16 2
34,568	Do. do. 6 % Cum. 1st Pref.	10	5 %	8 %	6 %	6 %	8 — 8½	8⅜ — 8⅝	8½	8 3/16	+ ⅛	Nil
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	£2 6	15 %	8 — 9	8 — 9	..	..	..	6 15 2
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	17 2 4

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000	5	..	..	..	..	4⅜— 4⅝	4⅜— 4⅝	96/3	94/4½	..	5 2 4
500,000	Do. 5 % 2nd Pref., 800,001 to 1,800,000	5	..	..	..	..	4 3/16— 4 13/16	4 3/16— 4 13/16	92/6	..	..	5 3 11
978,280	Do. 4 % Deb. Stock	..	..	..	..	4 %	92½—93½	92½—93½	93½	92½	..	4 6 6
332,387	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
680,000	Babcock & Wilcox, 1 to 680,000	1	20 %	20 %	20 %	20 %	4⅜ — 4½	4⅜ — 4⅝	9/3	90/-	+ ⅛	4 4 3
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	2 — 2⅛	2 — 2⅛	..	..	..	48 0 0
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	1⅞ — 2	1⅞ — 2⅛	..	..	+ ⅛	15 1 4
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	3⅛ — 3⅜	3⅛ — 3⅜	..	..	..	7 10 11
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	2¾ — 3	2¾ — 3⅛	..	..	..	6 14 3
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	..	5½%	5½%	5½%	95 — 98	96 — 99	..	..	+1	5 14 7
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	8 %	8 %	147 —152	142 —147	146	143	—5	5 8 10
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	5 %	6 %	117 —122	114 —119	116½	114	—3	5 0 1
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	109 —112	105 —109	108	106	—3½	4 11 9
233 000	Do. 4½ % 1st Mort. Debs., 1 to 5,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,900	100	4½%	4½%	4½%	4½%	102 —105	102 —105	104	..	..	4 5 9
188,801	British Electric Traction	10	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	13/9	..	..	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	8 %	14%	2 — 2¼	2 — 2⅛	..	..	..	6 0 0
1,473,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	85 — 88	84 — 87	86½	85½	—1	5 14 11
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	63 — 67	63 — 67	..	..	..	6 14 4
100,000	British Insulated and Helsby Cables	5	8 %	10 %	10 %	10 %	7⅛ — 7⅜	7⅛ — 7⅜	7 3/16	..	— ⅛	6 10 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6⅛ — 6¼	6⅛ — 6¼	..	..	..	4 11 3
600,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
204,940	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	89 — 94	89 — 94	..	..	..	4 15 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	3/16 — 7/16	3/16 — 7/16	..	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	38 — 42	38 — 42	..	..	..	9 10 6
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	9/32 — 11/32	9/32 — 11/32	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	3½%	Nil	Nil	Nil	0 — ½	0 — ½	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	6 %	Nil	Nil	Nil	0 — ½	0 — ½	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	41 — 46	41 — 46	..	..	..	9 15
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock.	Stock	4½%	4½%	4½%	4½%	27 — 31	27 — 31	..	..	..	14 10 2
187,610	Calcutta Trams, 1 to 187,610	5	8 %	8 %	6 %	4½%	4⅜ — 5	4⅜ — 5¼	5⅛	5 1/16	+ ⅛	4 5 9
45,804	Do. 5 % Cum. Pref., Nos. 1 to 20,880..	5	5 %	5 %	5 %	5 %	4⅜ — 5	4⅜ — 5	..	..	..	5 0
850,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
95,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	15 %	10⅜ — 11⅛	10⅜ — 11⅛	10⅞	10⅝	..	6 7 8
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5¾	5⅝	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105 —107	105 —107	..	..	..	4 4 1
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
450,000	Cassner-Kellner Alkali, 1 to 450,000	1	6 %	8 %	12 %	12½%	2 — 2⅛	2 — 2⅛	..	..	..	5 17 8
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4 %	105 —108	105 —108	..	..	..	3 14 1
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	4 %	3 %	3½%	62 — 64	62 — 64	..	..	..	5 1 7
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	85½	85	..	4 14 2
554,655	Do. do. Def. do.	Stock	4 %	4 %	2 %	2½%	43 — 45	43 — 45	..	..	..	5 11 1
1,480,000	City and South London Railway	Stock	1¾%	2¾%	3½%	1¾%	31½ — 32½	31 — 32	..	..	— ⅛	4 13 9
85,000	Crompton & Co., Nos. 1 to 85,000	5	2½%	5 %	5 %	5 %	⅛ — 1⅛	⅛ — 1⅛	..	..	..	13 6 8
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	90 — 93	90 — 93	..	..	..	5 7 6

* Unless otherwise stated, all shares are fully paid. † A period of nine months. From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1906.	1907.	1908.	Closing Quotations Sept. 7th.	Closing Quotations Sept. 14th.	Business done week ended Sept. 14th, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
250,000	Dick, Kerr & Co., 1 to 250,000	* 1	10 %	10 %	10 %	10 %	1⅛ – 1⅛	1⅛ – 1⅛	..	..	..	7 12 5
806,000	Do. do. 6 % Cum. Pref., 1 to 806,000	1	6 %	6 %	6 %	6 %	1⅝ – 1¾	1⅝ – 1¾	24/9	..	+ 1/32	4 14 1
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 –103	100 –103	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12⅜ – 13⅜	12⅜ – 13⅜	..	..	..	4 7 3
99,951	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,951	5	4½%	4½%	2½%	1¼%	5/16 – 7/16	5/16 – 7/16	..	..	..	24 0 0
19,189	Do. "A" shares, 01—019,189	5	4½%	4½%	2½%	2½%	1 – 1⅛	1 – 1⅛	..	..	..	8 6 8
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	68 – 73	68 – 73	..	..	..	6 9 7
67,730	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	84 – 87	84 – 87	..	..	..	5 12 4
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	7/16 – 1/2	7/16 – 1/2	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390..	2	7 %	7 %	7 %	7 %	1⅝ – 1⅞	1⅝ – 1⅞	..	..	..	9 13 1
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7½ – 8¼	7½ – 8¼	..	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	85 – 88	85 – 88	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	Nil	2 – 1	2 – 1	..	..	..	6 18 4
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ – 10¾	10½ – 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 –103½	102 –103	..	..	..	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15%	15 %	15%	15 %	12½ – 13½	12⅝ – 13⅝	..	..	+ ⅛	5 12 2
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ – 5⅜	5⅛ – 5⅜	5/16	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106 –108	105½ –107½	..	..	..	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works..	10	10%	10 %	10 %	10 %	14⅜ – 15½	14⅜ – 15½	15½	..	..	6 13 4
37,500	Liverpool Overhead Railway, Ord.	10	Nil	Nil	..	Nil	2 – 1	2 – 1	..	..	— 1/32	Nil
† 10,000	Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	4½ – 5	4½ – 4¾	..	..	— ⅛	10 10 6
600,070	London United Trams. (1901), 1 to 60,007	10	3 %	3 %	3 %	Nil	1⅜ – 2½	1⅜ – 2½	..	..	..	Nil
899,980	Do. do. 60,008 to 100,000	10	3 %	3 %	3 %	Nil	1⅜ – 2½	1⅜ – 2½	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	3⅜%	2⅜ – 2⅝	2⅜ – 2⅝	50/-	47/6	..	13 12 8
1,231,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	..	4 %	67 – 70	67 – 70	..	..	..	5 14 4
5,732,062	Metropolitan Consolidated	100	2⅜%	1 %	1⅜%	1⅜%	38 – 38½	37⅞ – 38⅛	38⅜	37⅞	— ⅛	1 6 2
2,640,914	Do. Surplus Lands	100	2⅜%	2⅜%	2⅜%	2⅜%	65 – 67	65 – 67	65⅛	65⅜	..	4 2 1
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	16 – 16⅛	16 – 16⅛	16 1/16	15⅞	..	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	..	..	4½%	19/32 – 21/32	19/32 – 21/32	..	..	..	..
314,016	Do. do. Defd.	1	Nil	Nil	Nil	Nil	5/16 – 7/16	5/16 – 7/16	9d.	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	11/16 – 13/16	11/16 – 13/16	16/-	..	..	6 3 1
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	94 – 96	94 – 96	..	..	..	4 13 9
10,828,200	Mexico Trams Co., Common Stock	..	..	..	..	..	128 –131	125 –128	129½	126½	–3	
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	..	5 %	93½ – 95½	90 – 92	94½	91½	–3½	5 8 8
245,500	Potteries Electric Traction	1	4 %	4 %	4 %	Nil	1/16 – 3/16	1/16 – 3/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 – 3/16	1/16 – 3/16	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	86 – 89	86 – 89	..	..	..	5 1 2
27,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	15 %	34½ – 36	34½ – 36	35⅛	34⅞	..	5 0 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 –102	100 –102	..	..	..	3 18 5
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	5 %	102½–103½	102¼–103½	103	..	..	4 16 7
2,800,000	Do. do. 4½% Bonds	..	..	..	..	4½%	89 – 91	88 – 90	..	..	—1	5 0 0
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	37 – 39	36 – 38	37	36	—1	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	5	Nil	Nil	10 %	Nil	5/16 – 7/16	5/16 – 7/16	..	..	..	..
66,666	Do. 6 % C.P., 80,001 to 80,000 & 125,001 to 141,666	1	Nil	..	6 %	6 %	2⅛ – 2⅜	2⅛ – 2⅜	..	..	..	1 18 5
245,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	78 – 82	78 – 82	..	..	..	4 17 7

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000		5½%	5½%	5½%	5½%	4¼ – 4⅜	4¼ – 4⅜	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	93 – 96	93 – 96	..	..	..	4 13 9
30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10 %	7⅜ – 7¾	7⅜ – 7¾	..	..	..	6 7 0
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7¼ – 8	7¼ – 8	..	..	..	4 7 6
836,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	97 –100	97 –100	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	4 – 4⅛	4 – 4⅛	..	..	..	5 11 1
80,000	Do. do. 4¼ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ – 4⅝	4⅜ – 4⅝	..	..	..	4 12 4
80,000	Do. "City Undertaking" 4¼ % Cum. Pri.	5	4½%	4½%	4½%	4½%	3¾ – 4⅛	3¾ – 4⅛	..	..	..	5 2 10
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 – 99	96 – 99	..	..	..	3 19 8
49,486	Chelsea Electricity Supply, Ord.	5	6 %	4½%	4½%	4½%	3⅞ – 4⅛	3¾ – 4	..	..	— ⅛	5 12 6
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 –103	100 –103	..	..	..	4 7 6
70,695	City of London Elec. Lighting, Ord. 40,001—110,695	10	6 %	6 %	6 %	6 %	10⅜ – 10⅞	10⅜ – 10⅞	10⅛	..	..	5 9 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ – 12¼	11⅜ – 12⅜	..	..	..	4 12 4
460,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 –124	121 –124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 –103	100 –103	102½	..	..	4 7 5
50,000	County of Durham Electrical Power, Ord.	5	4 %	4 %	2 %	..	2⅛ – 2⅜	1⅞ – 2	..	..	—1/16	5 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	8 – 8½	8 – 8¼	..	..	..	7 2 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	5 %	95⅜ – 95¾	93⅜ – 95¾	..	..	..	5 4 9
40,000	County of London Electric Lighting, Ord. 1—40,000	10	6 %	5 %	5 %	6 %	7⅜ – 8⅛	7⅜ – 8⅜	..	..	..	6 1 3
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ – 11	10½ – 11	10⅜	10⅛	..	5 9 1
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	104 –107	104 –107	..	..	..	4 4 1
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	100 –103	100 –103	101½	..	..	4 7 5
80,000	Edmundson's Electric Corporation, Ord. Shares	5	4 %	Nil	Nil	Nil	3/16 – 5/16	3/16 – 5/16	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	3 %	Nil	Nil	3/16 – 5/16	3/16 – 5/16	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	58 – 61	58 – 61	..	..	..	7 7 7
$3,150,000	Electrical Dev.Co.of Ontario, 5% 1stMtg.Gold Bnds.	$500	..	..	..	5 %	84 – 86	84 – 86	..	..	..	5 16 3
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½ – 5	4½ – 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 – 5½	5 – 5¼	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 –100	97 –100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	9 %	9 %	8½%	8½%	7⅞ – 7⅞	7⅞ – 7⅞	..	..	..	5 11 6
$1,876,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	5 %	98 –101	98 –101	..	..	..	4 19 0
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	10 %	8 %	6½ – 7	6¾ – 7	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 – 98	96 – 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	4 %	2½%	3 %	1⅞ – 2⅛	1⅞ – 2⅛	..	..	..	4 16 0
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	5 – 5½	5 – 5½	5⅛	..	..	5 17 1
882,855	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4½%	4½%	4 %	93 – 97	93 – 97	94⅛	..	..	4 2 6
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	8 %	6½%	5 %	4⅛ – 4⅜	4⅛ – 4⅜	85/-	..	..	5 7 6
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ – 5	4⅜ – 5	..	..	..	4 10 0
235,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 –108	105 –108	..	..	..	4 3 4
248,000	Do. 3¾ % Mort. Deben. Stock Redeem.	Stock	3¾%	3¾%	3½%	3¾%	83½ – 86½	83½ – 86½	..	..	..	4 0 11
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	5 %	83 – 85	80 – 82	82	81	—3	6 1 11
18,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	3½%	71 – 75	66 – 70	72½	68	—5	5 0 0
$3,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	7 %	106 –110	100 –104	107	104	—6	6 14 7
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.		..	..	..	5 %	85½ – 87½	82 – 84	86⅜	82½	—3½	5 19 1
260,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 – 98	96 – 99	85/-	..	+1	4 10 4
130,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	8 %	2½%	4⅛ – 4⅜	4⅛ – 4⅜	..	..	..	2 14 0
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4⅜ – 5	4⅜ – 5⅛	..	..	+ ⅛	4 15 3
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	..	99 – 101	99 –101	..	..	..	..
19,852	Notting Hill Electric Lighting	10	7½%	7½%	7½%	7 %	11⅜ – 12⅜	12 – 13	12½	12	+ ½	5 7 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6 – 6½	6 – 6¼	..	..	..	5 7 8
80,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 – 98	95 – 98	..	..	..	4 1 8
119,694	River Plate Elety. Co. Ord. Nos. 1 to 120,507	1	..	2½%	6 %	8 %	1⅝ – 1⅞	1⅝ – 1⅞	..	..	..	5 6 8
100,000	Do. do. 6% Non Cum. Pref. Nos.1 to 100,000	1	6 %	6 %	6 %	6 %	1 – 1⅛	1 – 1⅛	..	..	+ 1/32	5 10 4
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	103 –106	103 –106	..	..	..	4 14 4
40,000	St. James' and Pall Mall Electric Light, Ord.	5	12½%	10 %	10 %	10 %	8½ – 9	8½ – 9	..	..	..	7 2 10
90,000	Do. do. 7 % Pref. 80,081 to 40,080	5	7 %	7 %	7 %	7 %	7 – 7¼	7 – 7¼	..	..	..	4 11 10
450,000	Do. do. 3¾ % Deb. Stock Red.	100	3¾%	3¾%	3¾%	3¾%	84 – 88	84 – 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	Nil	Nil	Nil	3/16 – 5/16	3/16 – 5/16	..	..	..	Nil
85,000	South London Electric Supply, Ord.	4	4 %	3 %	4 %	5 %	3⅛ – 3⅜	3⅛ – 3⅜	57/6	55/-	..	6 13 4
126,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	2½%	1/16 – 3/16	1/16 – 3/16	..	..	..	4 8 11
142,268	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ – 1⅜	1⅛ – 1⅜	..	..	..	5 16 8
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 –105	102 –105	103	..	..	4 5 9
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	¾ – 1	¾ – 1	..	..	..	25 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅝ – 2	1⅝ – 2	..	..	..	12 10 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	77 – 81	77 – 81	..	..	..	5 11 1
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	5 %	31/32 – 1 1/32	31/32 – 1 1/32	..	..	..	5 9 7
110,000	Westminster Electric Supply, Ord.	5	12 %	12 %	10 %	10 %	8½ – 9	8½ – 9	8¹¹/₁₆	..	..	5 11 1
21,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1906)	5	5 %	4½%	4½%	4½%	5 – 5⅛	5 – 5⅛	..	..	..	4 5 0

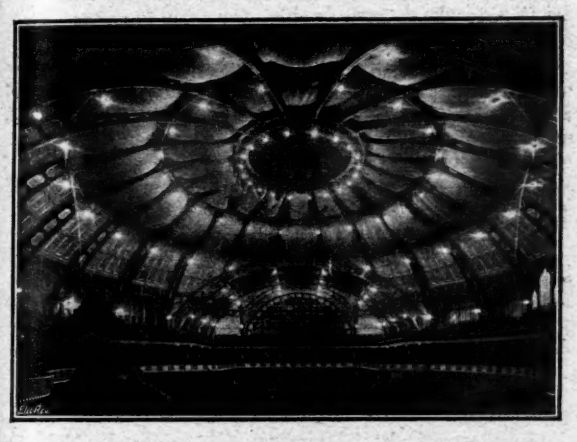
* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. Interim Dividend.

Bank rate of Discount 2½ per cent., April 1st, 1909.

THE LIGHTING OF A LARGE EXHIBITION HALL.

The accompanying photograph indicates the scheme of electric illumination adopted in connection with the recently completed public exhibition hall in Frankfort. The only hall which approaches this one as regards floor space is the Paris "Grand Palais," and there is room for some improvement in the lighting of the latter, especially in its central portion. The Frankfort hall is 365 ft. long, 220 ft. wide and about 90 ft. high to the cupola. Æsthetic and architectural considerations did not very well permit of arc lamps being suspended by long supports from the roof, and yet, owing to the great height, the use of arc lamps was essential. It was decided, therefore, to suspend a number of powerful lamps near the roof. The number of such lamps was practically fixed by the nature of the roof construction, as each junction in the iron-work formed a convenient natural suspension point, and the lamps thus placed would help to emphasise the main lines of the building.

Twenty flame arcs of about 4,000 c.p. each were, therefore, suspended from the high central elliptical ring, whilst the remaining 96 junction points received enclosed arcs of about 1,600 c.p. each. These arcs give an ample general illumination in the hall, but for use on special occasions something additional, in the nature of an



Electrical Illumination at the Frankfort Exhibition Hall.

ornamental illumination, was desired, and for this purpose an outline illumination by means of a large number of miniature incandescent lamps was decided upon. Some 20,000 2-c.p. lamps, spaced 5 in. apart, were therefore fixed along the centres of all the main girders, and also along the balustrades of the two galleries, whilst along the lower edges of the galleries rows of ordinary incandescent lamps, with a somewhat greater spacing, were fixed, to help in illuminating the spaces below the galleries.

The total candle-power of all the lamps installed amounts to about 400,000, and the power used is about 360 kw. For the sake of greater reliability, the arc lamps are supplied from a direct current central station in the town, whilst the incandescent lamps are connected to the Frankfort alternating supply, generated in a separate station in another quarter of the town.

The trimming of the arcs is carried out from galleries in the roof, the arcs being suspended on arms turning on vertical axes, and thus being readily drawn over the galleries when desired.

The general effect of the combined illumination can be seen from the view, but the pleasing blending of the various colours, which gave rise to many favourable comments, cannot, of course, be reproduced.—*A.E.G. Zeitung*, July, 1909.

SPECIFICATIONS FOR TRUCK PARTS.

We abstract below some of the standard specifications which have been adopted by the Brooklyn Rapid Transit Co. with a view to securing the safest and most suitable equipment, and in order that the policy of complete standardisation may be carried out to the utmost.

Reference should be made to the *Electric Railway Journal* of July 24th for the complete specifications and for drawings of certain parts.

Steel Tires.—The steel tires are of open-hearth or crucible steel, and in general conform to the standards outlined in Bulletin No. 14 of the American Society for Testing Materials. The chemical composition is limited as follows:—Manganese, not to exceed 0·80 per cent.; silicon, not less than 0·25 per cent.; phosphorus, not to exceed 0·05 per cent.; and sulphur, not to exceed 0·05 per cent. All tires must have a tensile strength of not less than 110,000 lb. per square inch, and their elongation in 2 in. must not be less than 10 per cent. All tires must be free from cracks, flaws or other injurious defects, and conform to dimensions ordered.

The steel tires covered by the foregoing are 2½ in. thick. The wheels used under the elevated cars are 36 in. diameter, and carry 9,000 lb. when the car is light. The elevated cars are operated up to a maximum speed of 40 m.p.h. The wheels used for the electric locomotive are 37 in. diameter, carry 14,250 lb., and are run at speeds up to 40 m.p.h.

Steel Castings.—The open-hearth or crucible-steel castings are to conform in general to the standards laid down in Bulletin No. 16, American Society for Testing Materials. In their chemical composition these castings must not have over 0·05 per cent. of phosphorus or over 0·05 per cent. of sulphur. Such castings must have a tensile strength of not less than 60,000 lb. per square inch, an elastic limit of not less than 27,000 lb. per square inch, an elongation of not less than 22 per cent. in 2 in., and a reduction in area of not less than 30 per cent. All castings must be annealed by heating uniformly to about 850° C., or 1,560° F. No castings must be shipped until it is certain that the proper crystallisation has been obtained. This is characterised by a fine granular section, a sample of which must be furnished upon request. Castings must be true to patterns and free from slag, blow-holes, shrinkage cracks and sand. Bearing surfaces must be solid, and no porosity is allowed in positions where the resistance and value of the casting for the purpose intended will be seriously affected.

Wrought-Iron.—The wrought-iron must be free from steel scrap. The physical requirements for both rectangular and round sections are:—Tensile strength per square inch not less than 48,000 lb. rectangular, or 50,000 lb. round; elastic limit per square inch not less than 25,000 lb. rectangular, or 25,000 lb. round; elongation in 8 in. not less than 20 per cent. rectangular, or 25 per cent. round. A reduction of 1,000 lb. per square inch in tensile strength is allowed below the above figures when it is necessary to machine test pieces. Bars are required to bend cold, without signs of fracture or cracking, through 90° to a curve whose radius equals the thickness of the piece. At least one sample in three must bend through 180° without cracking. Bars when nicked evenly and bent back by light blows must show a generally fibrous fracture, free from steel or coarse crystalline spots. Not over 15 per cent. of the fractured surface must be granular. Two test pieces, 20 in. long, are taken for test from each 200 bars or less. All bars must be practically straight, smooth, free from cinder spots, blisters, cracks, slivers, injurious flaws and imperfect edges. Round iron must conform to the limit gauges adopted by the Master Mechanics' Association, and rectangular iron must not vary more than ·03 in. from the size ordered.

Steel Forgings for Driving and Trailer Truck Axles and Armature Shafts.—The specifications for steel forgings for truck axles and armature shafts conform to those of the American Railway Master Mechanics' Association and the American Society for Testing Materials. The material is open-hearth steel with the following chemical limitations:—Phosphorus, not to exceed 0·05 per cent.; sulphur, not to exceed 0·05 per cent.; and manganese, not to exceed 0·60 per cent. The tensile strength must not be less than 80,000 lb. per square inch, the elongation not less than 20 per cent. in 2 in., and the reduction in area not less than 25 per cent.

Composition Castings.—Five different alloys are used for composition castings, as follows:—Journal bearings, check plates and various other bearings are of bearing metal, No. 1 composition; car trimmings, trolley wheels and various power-house castings are of bronze, No. 2 composition; signal bells are of bell metal, No. 3 composition; steam fittings, valves and cocks are of steam metal, No. 4 composition; and miscellaneous castings, motor and control parts are of yellow brass, No. 5 composition.

The analyses of the five compositions are given in Table I:—

Table I.

Composition.	Copper. Per cent.	Tin. Per cent.	Lead. Per cent.	Zinc. Per cent.	Maximum impurities. Per cent
No. 1, Bearing metal ...	77·00	8·00	15·00	—	1·0
No. 2, Bronze	88·40	5·50	2·80	3·30	1·5
No. 3, Bell metal ...	82·00	18·00	—	—	1·5
No. 4, Steam metal ...	85·00	5·00	5·00	5·00	1·0
No. 5, Common brass ...	67·00	—	—	33·00	1·5

Note.—A variation of 10 per cent. is allowed from the specified amounts of tin, lead and zinc.

Mixtures with scrap of the percentages indicated are permitted as shown in Table II:—

Table II.

Composition.	Copper. Per cent.	Tin. Per cent.	Lead. Per cent.	Zinc. Per cent.	Maximum scrap. Per cent.
No. 1, Bearing metal ...	38·50	4·00	7·10	—	50
No. 2, Bronze	62·00	3·80	1·90	2·30	30
No. 3, Bell metal ...	82·00	18·00	—	—	—
No. 4, Steam metal ...	59·50	3·50	3·50	3·50	30
No. 5, Common brass ...	—	—	—	—	100

Note.—All scrap must be of the same composition as the metal for which it is used, and where the amount of scrap, as shown above, cannot be obtained, new metals must be used in proportion.

Inspection must show that the castings are free from segregation, oxidation, dirt, sand, cavities and any other injurious defects.

Cast-steel Gears.—Cast-steel gears are of open-hearth or crucible steel, and must not contain more than 0·05 per cent. of phosphorus or more than 0·05 per cent. of sulphur. The tensile strength must be not less than 70,000 lb. per square inch, the elastic limit not less than 35,000 lb., the elongation in 2 in. not less than 16 per cent. and the reduction in area not less than 25 per cent. All gear castings must be annealed by heating uniformly to about 850° C., or 1,560° F. No castings must be shipped until it is certain that the proper crystallisation has been obtained, this being characterised

by a fine grain. The gears must be true to patterns and free from slag, blow-holes or shrinkage cracks. The finished surfaces must be solid, and no porosity will be allowed in the teeth.

Steel Pinions.—All steel pinions are of open-hearth steel of individual billets hammered to size for each pinion. The principal difference from the gear metal is in the use of manganese, which must not exceed 0·6 per cent.; phosphorus and sulphur must not exceed 0·04 per cent. each. The tensile strength of the pinion material must be not less than 80,000 lb. per square inch, the elastic limit per square inch not less than 40,000 lb. per square inch, the elongation in 2 in. not less than 22 per cent. and the reduction in area not less than 35 per cent.

All pinions must be free from seams, cracks or other defects, and must be finished to the exact sizes shown on the plans accompanying the order. The bore must be accurately and smoothly reamed.

Elliptic and Semi-elliptic Springs.—Car springs, whether of the elliptic or semi-elliptic type, are of crucible or open-hearth steel containing the following ingredients:—Carbon, 0·90 to 1·10 per cent.; manganese, 0·25 to 0·50 per cent.; silicon, 0·15 to 0·25 per cent.; phosphorus, not to exceed 0·05 per cent.; and sulphur, not to exceed 0·05 per cent. At least 25 per cent. of each lot of springs is subject to test. The trial consists in applying 1½ times the maximum specified load with the ends of the semi-elliptic springs supported on swinging or roller bearings. When released from 1½ times the maximum specified load, the springs must not be more than $\frac{3}{16}$ in. higher nor more than $\frac{3}{16}$ in. lower than the specified height, and must not take a permanent set when free. The plates must fit closely together at all times, and deflect uniformly under the test loads. The plate must be free from lamination and other defects, and must not vary more than ·03 in. in width nor more than ·02 in. in thickness. The bands must not vary more than ¼ in. in length, $\frac{1}{16}$ in. in width or $\frac{1}{32}$ in. in thickness. The distance, centre to centre, must not vary more than ¼ in. from drawings.

REVIEWS.

The Law Affecting Engineers. By W. Valentine Ball, M.A. (Cantab.), Barrister-at-Law. London: Constable and Co., Ltd. Price 10s. 6d. net.

This book primarily appeals to practising consulting engineers and the responsible engineering officials of the many large purchasing authorities. It deals with their powers and duties, both as between their employers and contractors, and in the rarer cases where they are called in to act either as expert witnesses or as arbitrators in disputed cases. As an exposition of the law regarding the interpretation of engineering contracts, it should also prove of service to the engineering officials of contracting and manufacturing companies.

The volume may be divided into four sections, namely, Chapters I to V, which deal with the duties, powers and responsibilities of the engineer; Chapters VI to XIX, which are concerned with various aspects of engineering contracts; Chapter XX, which is devoted to arbitration procedure; and the Appendix, which consists of several model forms of general conditions, forms of tender, and sample agreements. Amongst these are the "Model General Conditions" prepared and issued by the Institution of Electrical Engineers, which receive the author's hearty commendation.

In the first section the question who is a consulting engineer calls forth the answer that the term includes all who in an advisory capacity act as the engineering representatives of purchasers of engineering plant or materials. The necessity for a high standard of professional conduct is pointed out, and the suggestions made by the Institution of Civil Engineers in 1902 are detailed. The difficulty of enforcing any such suggestions without the legal powers which are vested in the governing bodies of other learned professions is mentioned.

The question of fees is then considered, and the importance urged of having a clear understanding on the following points—namely, their amount and the times of payment, whether extras are to be considered separately, and what would be the effect on the amount of a total or partial abandonment of the scheme after the plans and specifications had been prepared.

It is urged that all service agreements for periods exceeding one year should be committed to writing and stamped, and, if with a local authority, sealed, otherwise they will be held invalid in the Courts. It is suggested that a solicitor be consulted before such agreements are signed, as there are many points needing careful expression, particularly in regard to date of payments, length of notice to be given or accepted, restrictive covenants binding an employé after leaving an employer's service, and other equally important details.

The question how an engineer should act when summoned as an expert witness is then discussed. The importance is insisted on of making himself perfectly acquainted with the points at issue and of cultivating a clear, distinct manner in the witness box, so as to withstand, without aggression, the cross-examination of the opposing counsel, and to impress the judge with the correctness of his views.

The fact is noted that he is not bound to give a "yes or no" answer when qualifying expressions are necessary.

The fees chargeable for such work are then fully considered.

With regard to liability, it is pointed out that, while he cannot be held liable for losses incurred through his erroneous opinions or errors of judgment, he must display a "reasonable degree of skill" and must be careful to carry out effectually the work of supervision, or he may be held responsible for the consequences. Several instances are mentioned where considerable sums have thus been recovered.

The next section—Chapters VI to XIX—deals with engineering contracts. The need for care in their preparation is insisted on, and the difficulty of rectifying even palpable mistakes after the contracts have been signed is shown. Instances are given where applications to alter "£18 per cwt." to "18s. per cwt.," and "30s. per cwt." to "30s. per ton" have been refused.

A contractor is warned that he must satisfy himself that a scheme for which tenders are invited is practicable, and that he has no redress if events prove that the methods proposed in the specification are unsuitable, and the work has to be carried out in a more expensive manner. He should also be very careful of the use of the words "whole" or "complete" without being sure that all liabilities are covered in the price.

One chapter deals with tenders. That these should be in writing goes without question, verbal tenders being inadmissible in the Courts. The importance of care in choosing the phrasing is insisted on, and it is pointed out that a contractor cannot shield himself from its binding nature by calling it an estimate.

The right of withdrawal is discussed, and the illegality of tenders offering to accept a certain sum less than any competitor is proved from actual cases.

Reference is made to the Public Health Act of 1875, which enacts that not only must a public authority advertise for tenders, but also it must have specifications prepared for works carried out by them. It is shown to be legal for competitors to agree either to refrain altogether from tendering or for one selected party to make a firm offer, the others being knowingly considerably higher.

The duties of a quantity surveyor and the liabilities of his employer are then considered. The custom of the trade in making the builder pay his fees is mentioned, and it is stated that in law a contract holds, although based on erroneous bills of quantities issued with the specification, unless it can be proved that there was an evident intention to defraud.

The next chapter deals with the important question of specifications, and re-states their binding nature after acceptance by the contractor. It is a fundamental principle in law that the contractor fully acquaints himself with all risks, whether mentioned in a specification or not. The author, however, points out that though a specification is not a warranty that work carried out in accordance with its provisions will be satisfactory, it implies that ordinary care has been exercised in its preparation, and gives as an illustration some harbour works, where the plans issued with the specification showed a sunken wall which could be made use of. This did not exist, and heavy expenses were in consequence incurred. The engineer and his employer, not the contractor, were held responsible.

Plans and drawings when referred to in a specification form part of the contract. The need for care in approving contractors' drawings is referred to, and the responsibility

of the contractor to complete in accordance with them is insisted upon, as well as the necessity for an engineer to be specially authorised before permitting variations from an approved drawing. Reference is then made to the legal ownership of plans of completed works.

The next chapter relates to extras and alterations. The need for these to be expressly authorised before being carried out is insisted upon. Those who have had any experience with the consideration of the extras claimed at the end of a long contract, know how important it is that orders for extras should be definite both as regards what is to be done, and its amount. It appears that the law is very clear upon the liability of a contractor to complete work he has contracted to do, and it places the onus of obtaining sufficient orders for extra work, as well as of satisfying himself that the engineer has power to authorise it, upon the contractor.

The author then deals with the question of time of completion, the powers of an engineer to grant extensions, and the effect which extra work has upon the original contract date of completion. Engineers' certificates, payments, bonuses and penalties next claim attention. The difference between progress and final certificates is explained, and the legal effect of the issue of the final certificate is discussed; the engineer is reminded that as in issuing this final certificate he is acting in a semi-judicial capacity, he is bound not merely to be very careful how the certificate is worded, but also to hold the scales equally as between employer and contractor.

The author considers it advisable that all decisions of the engineer, including the final certificate, should be open to arbitration.

The prevalent idea that a penalty clause cannot be enforced unless accompanied by a possible bonus clause does not appear to be borne out in law. Indeed, it is pointed out that the Public Health Act of 1875 expressly enacts that "every contract made by Local Authorities must specify the pecuniary penalty to be paid in case the terms of the contract are not fully performed," and it has been decided in the Courts that this provision is mandatory. Here no question of corresponding bonus is mentioned. It is, however, pointed out by the author that the amount of a penalty must have some fair relation to the damage sustained, and he recommends that the description "agreed and liquidated damages" be used instead of the word "penalty."

As an illustration of penalties inflicted for departure from specification, the author cites a case where a penalty of £1,000 was inflicted by the Admiralty because a certain gunboat exceeded the specified weight by a few tons. When, later on, it was found that this was the only satisfactory boat of its class, the money was returned to the contractor as "an act of grace," not as a necessity of law.

Contractors will be specially interested in the next two chapters, which deal with maintenance and sub-contracting. The several forms of maintenance clauses, in some of which the contractor makes himself responsible for all accidents, and even the consequential damages resulting therefrom, while in others he is only responsible for defects due to defective design or workmanship, are discussed, and the contractor is advised to be careful in regard to what he accepts.

The engineer is urged to reserve to himself the power of approving the names of sub-contractors, while it is stated that such approval does not in law release the main contractor from any of his liabilities. Several questions as to the rights of the sub-contractor are discussed by the author, notably, to whom he must look for payment in the event of bankruptcy or insolvency of the main contractor after delivery of the goods, and to what extent he is liable in case of delay on his part to deliver a small but essential part of a large contract.

The functions and powers of an assistant engineer next claim attention, and it is made clear that it is not possible for an engineer to delegate the entire responsibility of supervision to an assistant, however competent.

The last chapter in this section is of particular interest to electrical contractors, as in it questions arising out of the supply of electrical energy and of electrical plant are discussed. For instance, if a supplier contracts to sell power, it must be suitable for the purpose for which it is to be used, if that purpose was known to the supplier when the contract was made, in the absence of special limitations as to what would actually be supplied.

Whether a cut-out and shunt resistance form integral parts of a "complete installation," or whether they can be charged for as extras, and whether "the actual cost of generating electric light" includes any allowance for depreciation of plant, and what are contractors' liabilities in reference to accidents through fire or electric shocks to third persons, are questions which are answered by references to actual legal decisions.

The third section consists of one chapter, in which arbitration procedure is fully treated. It points out the different classes of references, considers the phrasing of the arbitration clause usually inserted in engineering contracts, and gives much useful advice to an engineer chosen to act as arbitrator. It urges care in drafting the award to see that it covers, but does not exceed, the terms of reference, and suggests the advisability of taking legal opinion upon the phrasing used. The conditions upon which a Court of Law will revoke an award are considered, also the question of permissible fees, and the right of the arbitrator to have a lien on his award until the fees are paid.

There are two questions relating to engineering contracts not considered in the present volume, which might with benefit be fully treated in a future edition. One is the effect which beneficial use of part of a plant has upon its acceptance by the purchaser and the completion of the contract, and the other the question of tests, and the liability of a purchaser to take over plant which only in degree—that is, as regards performance guarantees—falls short of specification requirements.

The book deals with a number of subjects of daily interest to engineers and contractors, and while in some points the conclusions arrived at differ from those commonly held and acted on in everyday commercial life, there is no doubt that it will prove a very useful addition to the modern business library.

The Theory and Practice of Electric Wiring. By W. S. Ibbetson, B.Sc., A.M.I.E.E. London: E. and F. N. Spon. Price 5s. net.

The volume before us comprises 366 pp., is divided into 15 chapters, and has an Appendix of tables dealing with conduits and conductors. There are also about 16 pages devoted to City and Guilds' examination questions in wireman's work, 1903-1908, and a fairly comprehensive index to the whole book.

The author puts forward as one of the reasons for this essay into the field of technical literature that "the period has arrived when a wireman should be an electrician, and no doubt in a few years' time there will be few who do not possess certificates of competency, not simply in the jointing of cables but in electrical work generally. It is to further this end that the book has been written." It has also "been the author's aim to make as clear and concise as possible the facts necessary to wiremen, in order to perform their work intelligently and efficiently."

It has often occurred to us that the writing of a preface should be handed over by an author to a competent and friendly reviewer—"It wad frae mony a blunder free us." The result too often is quite out of harmony with the author's expressed aim, and we fear this volume is a case in point. The author of a text-book simply cannot be too careful in the choice of words to express his thoughts so as to render it unnecessary to read any paragraph twice over in order to grasp its meaning. Such lucidity is absent in this case, and this sometimes leads to humorous results.

The book opens with general principles in Chapter I, and these are fairly well treated; the statements made regarding current, pressure or voltage and resistance cannot be called definitions in any sense of the term, but may be sufficient for a wireman's use.

Chapters II, III and IV deal with resistance, measurement of resistance and Ohm's law respectively. This portion is nicely dealt with, and a number of numerical examples are worked out.

Chapter V is given over to the consideration of filament lamps, and is probably the haziest in the book. The fourth

line of the chapter, page 63, is marred by an interpolated "and," making the paragraph unintelligible. There are quite a number of slipshod statements in this portion of the book, and only a few instances can be quoted.

On page 65, "their life"—carbon-filament lamps—"is about 1,000 hours, and the efficiency drops 20 per cent. *at the end of this time*"; page 67, dealing with the decrease in resistance of a carbon filament with increasing temperature, we are told that "this makes the lamp very *sensible* to a rise of a few volts pressure when hot." On the same page we learn that high-efficiency (metallised) carbon filaments are obtained "by special treatment in the electric *arc!*" Page 71, tungsten filaments are obtained by "reducing the mass to the *constituency* of putty." Passing over others we find this on page 77: describing the "iron ballast resistance . . . enclosed in a small glass tube" used in the Nernst lamp, we are told that "the tube, *instead of being a vacuum*, is filled with hydrogen gas." Two pages further on, however, the following description may be of interest to the electrical trade: "Tubolite lamps are the ordinary filament lamps encased in long tubes, the sizes being from 1 ft. to 8 ft. 6 in. long. They have reflectors fitted to the back of them . . . ." An ordinary filament lamp 8 ft. 6 in. long is surely an achievement.

Arc lamps form the subject-matter of the succeeding chapter, and its value may be judged from the following: "It is very difficult by aid of diagrams to give a clear conception of the mechanism of arc lamps, but no doubt the reader will have ample opportunity of observing a lamp and should trace the path of the current through one and notice the actions which take place when the lamp is burning." Hence there are no diagrams or illustrations of arc lamp mechanism, and the descriptive paragraphs are often very confused and involved. The last paragraph on p. 92 has no apparent reference to the context, and ought to appear on p. 88.

Page 97—"The golden flame of the flame arc is due to vapours of the calcium fluoride or other calcium salts mixed in the carbons during manufacture to the extent of about 10 per cent., and *which are produced by the heat of the arc.*" There are apparently more things mixed than flame carbons.

In Chapter VII we come to distribution of power, and here there are some good diagrams, but the treatment is far too scrappy, the whole subject being disposed of inside 16 pages. The same remark applies to the following section, where instruments are illustrated and described. The chapter is quite inadequate for a text-book of this nature.

Chapter IX deals with fuses, cut-outs and switches. The relative advantages and disadvantages of lead, tin and copper for fuses are gone into, and a table is given showing the usual length of break allowed for various currents and pressures. Switches are similarly dealt with, and, generally speaking, this section is much better. There are many points, however, which might be improved.

Forty-eight pages forming Chapter X are devoted to systems of wiring, and casing, conduit, B.I.W. twin-wire, and "C.C." concentric systems, are illustrated and described in a fairly satisfactory manner. Regarding the latter system, the author seems to think that the making of the joints is a matter involving a great deal of time, and it may interest him to know that the writer has repeatedly made three-way 7/21½ junctions complete in from 5 to 7 minutes—much less time than is required for an ordinary joint in insulated wire.

The next two chapters dealing with joints, soldering, &c., and insulators and cables, respectively, are quite satisfactory, but in the thirteenth chapter the author is again unlucky. Here he deals with batteries and bells, and adds three or four pages on electric motor connections. Now what connection has a motor with a bell, or what fellowship has a starting switch with a bell-push? We are told that "it is rather difficult to show how motors can be intelligently fitted up without giving a chapter on motor construction." Then why not give such a chapter?

Testing for faults in cables in the next chapter is all right, but the author describes one highly dangerous way of finding a fault. He suggests earthing the live main, so as to burn out the earth fault on the other main. In an unskilled man's hands this would result not only in burning out the fault but also all the adjoining neighbourhood.

The final chapter is made up of descriptions and diagrams of the wiring for Lundberg's special switches, electric flashing signs, &c., and is useful enough to the average wireman, who cannot always obtain a catalogue showing such connections.

As far as we are aware, this is the author's first effort in technical literature, and it is because *experientia docet* that we have devoted more space to a criticism of this book than the subject deserves. A reviewer is only human, and it is in no captious fault-finding spirit that we conclude by remarking that practically throughout the volume the author's thoughts seem to have been in a condition similar to that of some wires behind a distribution board, which he graphically describes on page 133 as "being crossed and recrossed in a perfect *mêlée*."

"Further, by these be admonished; of the making of books there is no end, and much study [of them] is a weariness to the flesh." J. D. M.

THE ENCLOSED ARC, OR THE METAL-FILAMENT LAMP?

By "PAM."

It must often be noticed that although all kinds of apparatus are described and discussed in the electrical Press, arc lamps seem to be quite ignored, and in view of the remarkable improvements which have recently been made, this is all the more surprising.

Perhaps they are most in evidence in "Situations Vacant"—for travellers to sell on commission, &c.

No doubt this is a reflection of the difficulties which manufacturers have in disposing of their goods, and it is a fact that arc lamps want a great deal more selling than the usual run of things; this is especially noticeable in comparison with the business as "played" seven to ten years ago. Then it was a "bed of roses," now—"thorns," and long ones, too.

The chief cause of this is, of course, that good old price leveller—competition—but Osram and its fellow lamps have given arcs a very nasty shock.

Now, what I cannot understand is the apathy of manufacturers and those interested in arc lamps generally. They have enough fighting material at hand to swamp all the adherents of other artificial illuminants, if they could only muster enough energy and intelligence to put things plainly before the general (electrical) public. I am sure that anyone thinking of illuminating must have noticed the claims of metal-filament lamps, high-pressure gas, &c., which are advertised and pushed in such a manner that it is not a matter of looking for information, but rather trying to get away from it. On the other hand, notice the advertisements which generally appear for arc lamps. It is the general rule that nothing is shown but a few illustrations of external appearance of lamps, which convey no meaning at all to the average reader, and I have come across scores of people who think that arc lamps are not as efficient as metal-filament lamps. This is a direct result of the unintelligent advertisements displayed. If the arc lamp people would only give a few details as to what they actually can do as regards candle-power for carbon and watt consumption, as the incandescent lamp people do (both electric and gas), they would be shaping better and doing themselves some good by advertising.

Speaking of the usual lack of figures, I should like to state a case which I came across some time ago. A certain firm sent inquiries to several dealers for flame lamps for shop lighting. The current was specified as 10 amperes, the voltage 200, and the lamps were to run four in series; and tenderers were requested to state the mean hemispherical candle-power of the lamps offered. Now one firm actually gave this as 4,000, and another as 3,000. This, mark you, for an expenditure of only 500 watts, which shows 8 C.P. per watt.

Such ridiculous figures as these are certain to do a lot of

harm to everyone concerned, but not least to the firm giving them, as such things are sure to be gone into, if only on account of their sensationalism.

The latest advertisements for metal-filament lamps are stating that these are more economical than enclosed arc lamps, but these claims cannot be substantiated, as will be seen from the figures given below.

Take the case of an ordinary shop, using four lights for either inside or outside lighting, and assume that each lamp is desired to give about 600 C.P., the voltage is 200, current is charged at 5d. per unit, and the lamps will be in use each day from dusk until 9 o'clock, or about 1,000 hours per annum.

If enclosed arc lamps are to be used, a good make can be obtained for £2 10s. each, and I have estimated that 20 per cent. depreciation is generous. As regards trimming, this would only have to be done 10 times per year, and if there is no one on the job who can do it, the local electrician would willingly take this on at, say, 4s. per visit (one hour's work).

In the case of metal-filament lamps, a life of 1,000 hours has been allowed, although 700 to 800 would be nearer the average. The lamps installed would be a good make listed as 700 Hefner C.P. (630 British) consuming 800 watts.

ENCLOSED ARC LAMPS.

	Cost per annum.		
Four lamps complete at £2 10s. each = £10; 20 per cent.	£2	0	0
Trimming and carbon, 10 visits at 4s.	2	0	0
Energy, 600 watts × 1,000 hours × 5d. per B.T.U. ...	12	10	0
	£16	10	0

METAL-FILAMENT LAMPS.

Four lamps, depreciation on lanterns, &c., say, 25s. each	£5	0	0
Energy, 800 watts × 1,000 hours × 5d. per B.T.U. ...	16	13	4
	£21	13	4

This shows a saving of £5 3s. 4d. in favour of enclosed lamps, and the estimates are all generously inclined to the other lamp, and no mention has been made of the possibility of little boys with stones or other unforeseen things occurring, which might ruin a metal-filament lamp in its youth.

Of course, no one needs to be told that flame lamps give five times the light for the same current as an enclosed arc lamp, and that the high cost of carbons is accordingly covered in a few weeks.

The object of the above deductions, besides calling the attention of all interested in lighting to the great misconceptions which are prevalent regarding the humble enclosed arc lamp, is to rouse the vendors from the awful state of lethargy which they seem to be in, in the hope that they will muster their forces of advertisement and argument, to oust the metal-filament and other lamps from the false position which they have attained.

BRITISH TRADE WITH CHINA.

[COMMUNICATED.]

In giving this small collection of words the above title, I would say that nearly all that follows refers to trade with China, but a great many of my remarks might equally apply to British trade with other countries.

I am afraid it is rather an ambitious task for a novice of the pen to try and convince the English engineer and financier that it is high time to drop the policy of "masterly inactivity" of which they seem so proud, and to set to and try to hold the position of commercial superiority which has been ours for so long; that position is slipping from us, or we are slipping from it, at an alarming speed. If once we lose it, we shall never regain it, for there is no real reason why London should be the world's commercial centre.

Before I took up my residence abroad, England to me was the pivot on which the globe revolved; her financial and her technical men, also her merchantmen, were the last words in brightness and energy, and were full of enterprise—I have of course always appreciated that there were other people on the earth, but poor people, and how sorry I was for them because they were not born on our blessed isle.

On my return to London after several years away, I received a horrid shock, and I cannot describe what my feelings were when I found this country labouring under the spell of the most virulent disease that can possibly attack a nation, firm, or man, and which is best described as "swollen head." The swelling was maintained by a false sense of superiority, which once we could fairly claim, but unfortunately for us that day is past, and if I could only impress upon the people of this country that they must give up trying to make extra profit just because they are English, and because the article they are selling has been made or designed by their own fair hands, I should feel I had not lived in vain.

Now take the home manufacturer dealing with an inquiry from abroad—will he give a c.i.f. quotation? No, he will not, unless you are his agent, or you have done business with him before, and as it is impossible at the other side of the globe to obtain freight rates from England, the poor engineer man has to guess the rates, and if he makes a mistake, the loss is his. I will tell you without fear of contradiction that the manufacturer will sometimes give a quotation "*ex* works" or f.o.r. Now, how on earth can a firm, say in China or Japan, or some other far-away spot, guess the freights from a works, say in Birmingham?

If home firms do not want to trade with distant lands, they should state in their advertisements and catalogues "No export trade done," because owing to these absurd methods, the poor people at the other side of the globe often get left, and the business goes elsewhere, generally to Germany or America.

To one just home it is beyond understanding to hear some of the remarks and sentiments expressed by some of the larger engineering manufacturers.

I brought home with me some most valuable details as regards prices, all conveniently tabulated, and the only thanks I got was: "Oh, yes, I see we are much higher, but we do not try to compete with foreign manufacturers." For Heaven's sake, why not? In no country in the world is skilled labour so cheap and efficient, there is no country in the world with such shipping facilities, and iron and coal is here in abundance, and yet it is impossible to compete! It is no earthly use telling a Chinaman or a Japanese that he must pay more money for a certain machine, because it was made in England, and that the firm which made it is a hundred years old. The day for that sort of thing has gone by, because when we could say it, our competitors were in their manufacturing infancy, and had not the capability of competing with us, but now, after assiduously studying our methods and improving on them, they are at least our equals, and in several ways they get ahead of us. They do this, first, because they can obtain financial assistance more easily than we can, and they in their turn assist their foreign agents; secondly, because their Consular services are far superior to our own.

In mentioning the Consular service, I would particularly ask you to note that I do not decry the very able and courteous body of men in that service, but I condemn the present system. I think it would be little short of suicidal if we did not have men of birth and education at the head of the service, but where I think the system is wrong is here. As is well known, at Embassies and Legations in any country there is a Commercial Attaché. It is his duty to look after commercial enterprise for his country, but if anyone expects one man to efficiently guard the interests of his country in an empire the size of China, he had better be put in an asylum. In China we have a commercial Attaché of great capability and energy, and one who, if an English firm applies for information, gives all that is asked for, and sometimes even more—the gentleman I refer to is Sir Alexander Hosie. Now I would suggest that the commercial branch of the Consular Service should be improved somehow on the following lines. We should appoint one commercial Attaché as at present, but give him a large staff of assistants, placing one at each Consulate, these assistants to be taken from business life, not from college just after passing their examinations; let them be engaged from the service of firms in the country they are to work in, so as to be certain of their knowing local conditions.

I can think of nothing more foolish than sending out a youngster who is fresh from college, and who has no commercial experience, to get in touch with the people and conditions and to report on possible business.

Since I have been home I have preached often and volubly against the deadly apathy or sleeping sickness which hangs over us, and I am glad to see letters in the *Times*, leaders in the *Observer*, and occasional notes in the *Pall Mall Gazette*, all in the same tone, pointing to lack of interest shown in this country as to the vast importance of the China trade.

On Saturday, August 28th, the *Times* said: "British commercial preponderancy is still an asset of immense value which deserves the support of more consistent and determined policy than this country has of late years maintained in China."

The *Observer*, of August 29th, growls because the Americans insisted on participating in the Hankow-Canton railway loan, and infers that they are poaching on our preserves. To get at the truth of this matter, I do not think we have to look further than H. E. Tong Shao-Yi's visit to Washington this year to thank the U.S A. for returning the Boxer Indemnity, and it is my firm belief that this move was suggested then. When one looks over the history of the relations of the last two years between China and the U.S.A., one will see very good reasons why China should turn to America for support.

We must take many things into consideration, one of the most important being the encouragement given by the U.S.A. to China to send students over to the American Colleges. *We give no special facilities.* The return of the Boxer Indemnity, the two visits of such an important man as Mr. Taft, one with Miss Roosevelt, and one at the eve of his election as President of the U.S.A., were far-sighted moves. We have sent no man of special fame or importance! Last, but in no way least, the vapourings of the American Press about raising the Legations at Peking to rank of Embassies, and wild suggestions of an American-Chinese Alliance, have to be remembered. These last two points, though not being looked upon with any interest by the intelligent reader or student of International affairs, would be contemplated by the Chinese with great pride and pleasure.

In what I am about to say I do not wish to appear to run down the Chinese in any way, but how could China rank as a recognised power yet, and what could she give America in return for an alliance? I am fully convinced that the United States is at present in far higher favour in Chinese eyes than any other nation.

To conclude, I would say that if our manufacturers wish to continue to do business in the Far East, they must give more support to the people who act for them, or they will find that the Englishman abroad will turn aside and take up dealing with foreign firms; that would be quite an easy thing for him to do.

I suppose my firm receives 50 letters from the Continent and America to one from England suggesting business relations.

Our firms must give c.i.f. quotations when asked for; they must improve their catalogues; they must not say, when approached to reduce their price to get business, "that it is their standard machine, with their name on it," and "it is the best on the market, and they have made it for 50 years, and have always had the price asked, and if the prospective purchaser does not like it, he need not buy it," as to have such things written and said to one, makes one just a bit annoyed.

The next point I take does not apply so much to the electrical branch of the engineering trade as to the mechanical.

On the question of quality I wish to impress upon Britishers that it is not necessary to quote us in the East for material made to comply with the B. of T. or to the British Standard specifications; these do not come into force at all unless specially asked for.

We in the East want good, but not extravagant, stuff; we want to be able to rely on it, and be certain of the wheels turning round, but we do not want it to last 1,000 years. I will give the best instance I can. In early June this year I received an invitation to be present at the opening of a new railway near Canton, which had been built and financed entirely by Chinese. Well, I went, and found the rails too light, the rolling stock of a cheap and nasty variety, and the locomotives remindful of an asthmatical pug with iron wheels. On being asked by the chief engineer my opinion of the line, I told him he had got the most beautiful collection of mechanical trash that I had ever seen. His reply was, that he knew that quite well, but as he was not absolutely certain of the commercial success of the venture, he thought it better to start by being cheap, and improving as he made money.

That is entirely illustrative of the Chinese methods, and if you want the Chinaman's business, you have got to accept some of his ideas.

NOTES ON TRADE ABROAD.

(*Continued from page* 411.)

China.

In the article commencing on the page that precedes this we are enabled to publish some spirited observations regarding the British position in, and attitude toward, the Chinese market. The reader will note the bearing of these criticisms—from one who is on quite familiar ground when expressing them—on the whole of our trade relations with that part of the world. Electrically, as we have already said in these pages, the actual demand in China is small at present; but it is a more than thrice-told tale that those who are "in" at the beginning of a particular development stand a better chance than others, one reason being that they have an important influence in creating, or deciding the character of, the demand that will come later. "Once used, always used," may apply to a popular commodity, but the clause conveys an idea of the kind of thing that happens in a field where the electrical demand, which is sure to come before very many years have passed, will be decided largely by the local circumstances, and partly by the attitude of the Chinese mind after having digested what it has observed in more advanced civilisations, but probably more largely by the electrical engineers and exploiters and traders of England, America or Germany, who make available manufactures which, broadly considered, fit the case as far as it is reasonably possible to foresee it.

Patience and Capital Must Combine.

Those who are anxious to do business in this coming field must understand that if there is any foreign market in which patience is required it is China. There has to be a preparing of soil, a seed-sowing, and a period of waiting, before a harvest of profitable business can be obtained. Here and there a concession may be secured or an order or two booked, but, generally speaking, it is first necessary both to get to know the Chinese character and to get yourself well known. "Preparing the soil" and getting to "know the Chinese character" involve an intimate knowledge of human nature, and of certain weaknesses which are recognised to exist in the Celestial Empire far more generally than they obtain in the United Kingdom. Patience such as we have referred to naturally means that in order to hold on one must have substantial capital at one's back. It is useless to think one can become rooted in China without it.

There is a vast hoarded wealth in China which the owners thereof are not averse to turning over if they have brought to their notice a form of enterprise and investment out of which they are convinced they can make a good thing. Assume, for instance, that it is desired to construct a railway; first, a small section would be laid out on the cheapest possible lines, producing a good profit because of the small capital outlay involved. In this way you have convinced your Chinaman that you have a scheme which will pay handsomely, and then he will enter warmly into it, and you can construct a larger and more substantial undertaking. It is very much the same sort of procedure as happened in our own towns and cities when the electric tramway came along. A municipality put down a short section of trolley system, the public hailed it as a boon, the traffic receipts were most gratifying, and very soon many more miles of track were felt to be an absolute necessity.

In Touch with the People.

An American Consular official at Tsingfau, alluding recently to the depression of trade throughout China, remarked that the number of travelling salesmen was gradually decreasing. "Thus American exporters of some lines of goods who covered this territory regularly a year ago, now have no men in the field at all." An amusing illustration of the enlightenment that is coming over the Chinese people as the white population becomes larger is found in their attitude toward patent medicines. It used to be the common method to relieve one pain by causing another, but this practice of the natives has lost its hold in many circles as American and other foreign firms have extensively advertised their patent medicines throughout the Empire with display posters. The paper of the latter is in gaudy colours, gives a picture of the medicine as placed on the market, and, furthermore, has Chinese reading matter. Quite a big and regular business is being done. There is little in common—we will not say nothing—between patent medicines and electrical goods, but the case is worth noting as indicating that prejudice does not prevent the Chinese from embracing a foreign article if they think they are going to gain thereby. We are not sure whether electric body belts and shocking coils have been brought to the relief of the Chinaman. The time may come—who knows?—when some of these artistic metal-filament lamp posters, upon which our firms spend so much ingenuity and striking colour, may, with Chinese inscriptions, adorn the streets of Chinese cities, and by energetic work in an unlimited field sweep out such cobwebby and antiquated household illuminating devices as are now in fashion, and bring in a new era for the lamp-maker at home and the British-equipped (?) central station.

Recognising a Need and Meeting it Early.

Another American Consul reports upon the methods adopted by an American gramaphone firm in catering for Chinese trade and pandering to the peoples' eccentricities. An energetic and experienced representative went out in the summer of 1907, after the agency for his goods had been excellently worked by one of the largest musical goods houses in China. He co-operated with this firm in enlarging the field of operations and they now have agencies in almost every treaty port in China. "The head agency at Shanghai has eight or ten Chinese salesmen continually in the field, and every detail of the trade is being carefully watched. For instance, it was found that the black horn, which was suitable for the home trade, did not appeal to the Chinese eye. The company have now placed bright red and yellow horns on their machines, and they are very popular."

Here again we are not actually on electrical ground, but we see how thoroughly other exporting countries are getting close into touch with some of the needs or fancies of the people. With electrical goods the case may be different, and consequently will call for a variation of the treatment. We may not yet find it worth while to go and sell switches and lamps and electric fans and so on to the millions in China,—either with or without an agreement with the Contractors' Association—seeing that they have not the electric supply at their doors; but there are such things as isolated electric lighting plants, petrol-electric sets perhaps, and equipments and other such lines, that the better classes of Chinese might now be induced to "cotton on to" if we were to lay out the proper organisation to reach them. Perhaps we are looking a little too far ahead, but it is no good overlooking possibilities altogether because we have not yet got evidence that the demand is being catered for.

How a German Electrical Company Succeeded.

Let us see how a Continental electrical firm have succeeded in their efforts to become known in China. An American Consul (W. T. Gracey, of Tsingtau), in reporting on electric light plants in cities there, states that a certain German firm had considerable success during a few months early this year in securing contracts. This firm, whose headquarters are in Berlin, has a branch house in Shanghai, and others in Tsingtau, Hankow, Tientsin and the other large ports of the Far East. A full supply of electric lighting supplies, sample plants, &c., is kept at each branch house, so that intending purchasers are able to see the entire plant in working condition. "This undoubtedly," he says, "is the best way to secure orders for this class of goods, and the success of the method of pushing trade by personal representatives and goods on the spot is shown by this company's recent success."

An electric light plant installed in Kirin recently was put up and successfully started by this German firm. The plant consists of two boilers by Borsig, supplying steam at 150 lb. pressure to two high-speed compound engines built by W. H. Allen & Sons, Bedford. The engines are coupled direct to 165-KW. alternators supplying three-phase current at 5,000 volts with a periodicity of 50, which is transformed down to 220 volts for consumers, the alternators having been manufactured by the German firm mentioned.

In February the same company also inaugurated the electric light in Soochow, a city of 40,000 inhabitants, and this station is now regularly supplying current to consumers. In this plant there are three Krupp Lancashire boilers, two open-type Schickau engines running at a speed of 250 revolutions, arranged with a jet condenser and air pump worked from the low-pressure crosshead. The engines are coupled direct to German 175-KW. alternators, generating three-phase current at 2,200 volts, the area of distribution being less than in Kirin. Current is transformed down for consumers to 220 volts. The number of lamps being connected is increasing daily. The same German company has also secured the contract for lighting Mukden, Manchuria, a city of 180,000 people, and the initial installation will consist of one 250-B.H.P. Belliss engine and one 350-KW. dynamo.

Future Power of American Finance.

American banking authorities are greatly impressed with the opportunity that exists for industrial growth and expansion in China, and they are, by the establishment of the American Bank in Peking, endeavouring to show that the financial strength and power of the United States is such as to render it unnecessary to look to Europe for capital as they have done up to the present. Mr. Willard D. Straight, the representative of the Bank named, when in this country recently, spoke enthusiastically of the United States becoming regarded as a World Power in financial and other matters in the Far East in railway work, coal and copper mine development, the creation of a mercantile marine, and so on. In efforts of this nature the Government authorities in Washington are lending valuable co-operation. An American Consul, in discussing the ability of the British and Chinese Corporation to handle in an intelligent way commercial matters of any magnitude, and its influence on future railroad construction, remarked: "British capitalists, manufacturers and commercial houses realise that the business of the future in China can best be secured by present efforts and that such efforts should be made here, not with a view to immediate profits so much as with a view to securing a foothold for the future. American manufacturers will work at a disadvantage in their efforts to meet competition in the China trade until American money invested in Chinese enterprises, and American representatives promoting American interests, bear a more equal ratio to the English and German capital and agents engaged in the trade of China."

It is interesting to read such views by our trans-Atlantic friends regarding the strength of the British position, but comforting as it may be, it has to be recognised that in the future we have got to meet a keener competition than has been experienced so far, and weak places in the armour, such as are pointed out on another page by our special contributor, call urgently for our attention.

Railroad Possibilities.

For many years to come, no doubt, the great bulk of the engineering operations in China will be connected with railroad construction and equipment, and American firms interested in these lines are being urged to see to it that American goods are represented by American agents. The Chinese are themselves making progress in the manufacture of railway materials, rolling-stock, &c.; indeed, for some years past rails have been supplied by the rolling mills at Han-yang, and the T'ongshan shops are building passenger and freight cars and other supplies. Railways are contemplated throughout all parts of the empire, connecting the interior with the ports. Chinese merchants subscribed the

capital for 134 miles of line from Honan Fu to Tung Kuan at a cost of £1,300,000, and the work is to occupy three years. This line will eventually proceed to Hsian Fu with its population of 1,000,000, which total extension of 800 miles will still leave the terminus less than halfway from Tientsin to the western frontier of the empire. Some idea of the nature of the work involved may be gained from the fact that the principal of three mountain chains *en route* reaches a height of 20,000 ft., and is covered with vast glaciers. The cart road from Hsian to Lanchau is said to cross the range at an elevation of 10,000 ft. The Ministry of Posts and Communications recently memorialised the Chinese throne, proposing great railway extensions in the north-west section, urging that they should be pushed and planned for with all energy, and the memorial has been approved of by the Government, which apparently is fully alive to the enormous importance of establishing communication. The American Minister at Peking states that, besides four or five Government schools now teaching railway engineering, another is to be established at Tientsin. "A rail-making plant is to be erected at T'ai-Yuan-Fu, and every department and district touching the north-west railway is directed to plant 30,000 elm trees, in order to provide ties for the future."

There is little doubt that the Chinese will not be dependent upon the "foreigner" any longer than he can help. Even British and American missionaries report that no sooner have they succeeded in establishing a church than the Chinese, though grateful enough for their pioneering and Western education facilities, are anxious to be left to their own resources and to manage their own affairs. This characteristic will, beyond shadow of a doubt, develop, as time goes on, in other matters, but we hope that there may be many years in which to do a profitable electrical trade before the foreigner can be dispensed with in this department. Chinese students study electrical and other engineering subjects in American colleges, and study American electrical text-books. They occasionally come to colleges in this country and study our text-books. The extent to which they do this kind of thing may go far to affect the kind of electrical system and material employed in China. The point is one to brood over.

We might indulge in all sorts of romancing concerning the multitudinous other developments that follow "in the train" of the railway, but it is a little too superficial for us to enter into a story of what has happened here and in every other country since the railway opened up communication and made a thousand and one kinds of development possible that were not dreamt of before. No doubt, with local variations, history will repeat itself in China.

American Weaknesses in the Chinese Field.

A comparison of American business methods in China with those of European parties is made by American Consul Williams of Chefoo. He says that a great weakness in American trade methods is the custom of placing the business of a large number of trade agencies in the hands of one firm handling everything from seeds to locomotives, the business being carried on in one or two small rooms. "American manufacturers should understand that China has passed the pioneer stage of doing business in the old-time country grocery style. American firms have combined on a machinery agency, and this combination ought to be not only instrumental in giving new life in this line of products, but it may be the possible solution of the best method of selling other American products in China. In this connection the suggestion is offered that while, as a rule, merchants should be willing to receive suggestions from a foreign agent, it is always best that the agent should be a man of tact and patience, who knows how to put himself behind rather than in front in all his dealings with Chinese traders."

Another Consul (in Nagasaki, Japan) reprimands American exporters to the Far East for the injury that they are doing to that trade by bad packing and lack of courtesy. A case is cited of a consignment of articles which arrived in damaged condition owing to their being badly packed. The local business house complained, and for their pains received a rather curt letter, saying that the exporting firm "believed its men knew how to pack goods." Other consignments continued to arrive in the same condition, until ultimately the orders were transferred to a foreign house which was prepared to guarantee the condition of shipments. It is fair to say that some Chinese business has been transferred to London for the same reason. This Consul quotes an article from a Far Eastern paper, in which the following comments appeared :—

The complaint as to packing is very general against American firms, as is the one that they show little or no interest as to local demands and local requirements in foreign markets. As is a well-known fact, there are varying conditions in all foreign markets, fixed by the consumer, and experience is showing that the man who meets those conditions to a greater extent than his competitors, gets the business. American manufacturers have as a rule shown a fine contempt for this condition, and in many places they have, for no other reason, been nosed out of the business. These are among the reasons that make us welcome the forthcoming visit to the Orient of a large party of American business men. They have much to learn about trade conditions in the Orient, and the best way to do it is to go over the ground personally.

Some idea of the transport difficulties that may have to be met with in certain parts of the great Chinese "continent," owing to the comparative absence of railway communication, may be conjured up by remembering that all materials for the 800-ft. bridge over the Yellow River at Lanchowfu, Province of Kansu, which is nearing completion, had to be conveyed nearly 1,000 miles in carts.

From the Errors of Others let us Profit !

Yet another Consul has been driving it home to the American about his remissness in the Far East. Really, if we read much more, our trans-Atlantic cousins will fall from grace in our estimation of them as exporters. A commercial traveller who has spent 20 years selling American goods in China, the Straits Settlements, Burma and India, after comparing the immediate possibilities in China and India to the advantage of the latter, said that the main trouble in the way of American-made goods was the manufacturers themselves. They did not take a personal interest in finding out what was required, nor did they look carefully after filling orders and packing the goods.

In other words, the American manufacturer has had too much to do at home to pay much attention to the details and requirements of the Far Eastern and Oriental trade. The result has been that goods have been sent to China and India that ought never to have been sent, and packed in a way to discredit the American exporter and to make it impossible in many cases to get a second order. Add to this the uncertainty of delivery, and a rather discouraging situation is presented. He thought that the United States should have a line of steamships, run on a regular schedule, to India and to points in China, say once in two months. This would ensure certainty of delivery, and at the same time accustom the eastern peoples to the American flag, and keep before them the opportunities of trade with the United States.

He also thought that an exposition warehouse in the large port cities of India would be excellent for the display of American goods suited to the requirements of the country, to be in charge of a capable and trustworthy man with the necessary assistants to "talk" the goods and to take orders. In connection with this continuous exposition would be an advertising bureau, which could keep before merchants and others the American goods on display and the advantages offered to would-be buyers. This plan is not new. In fact, much said by this experienced commercial salesman has been repeatedly set forth in reports, not only from this Consulate but from others. It all goes to emphasise the need of adopting suggestions that proceed from the experience of persons who have occupied this field for years and know what they are talking about.

What an American Consul is Doing to Help.

The American Consul at Amoy has, with commendable enterprise, prepared a printed catalogue of American trade catalogues, business directories and trade journals received at that Consulate in China. He has sent a copy of this index catalogue to each importing firm in that district, together with the following letter, which we print, to support the views expressed on another page concerning the insufficiency of the present British Consular trade representation in China. With American Consuls so active in trade matters in all parts of the Empire, there is a pressing demand for some more far-reaching British trade agent service such as our contributor advocates.

I beg to inform you that all trade catalogues, business directories and trade journals received at this Consulate from American manufacturers and dealers are properly catalogued and placed in the commercial library of this office. I take the liberty to send you enclosed herewith a complete catalogue of all trade publications at present on file in this library, and cordially to invite you to call at any time during the office hours of this Consulate to consult any of the publications therein enumerated. I shall be pleased indeed

to be of any possible assistance to you in placing you in touch with American manufacturers and dealers, and respectfully request that when such assistance is desired you favour me by availing yourself of my services.

This Amoy Consul (Julean Arnold) has set aside a certain space in the Consulate for the library of American trade publications, and has provided tables and writing materials for the use of those who wish to consult the library.

Traders should Protect Themselves.

Early in the present year a case was before the Mixed Court in Shanghai in which a Chinese shopkeeper was fined for selling a European imitation of an American article which had been sold in China for 20 years. The European article was of inferior quality, and bore the trade mark and boxing of exact pattern and size, with one or two minor changes, so that it was possible only after minute examination to discover the difference. The Chinese who was fined for handling the goods had to give security that he would not sell the bogus brand in future, and all the articles in his possession were confiscated by the police. An American Consul, in reporting the matter for the benefit of traders at home, mentioned it as an illustration of the necessity of having trade marks lawfully registered in all the principal countries in the Far East. "The Court had, of course, no jurisdiction over the European company which manufactured the imitation, but if the American merchant had had his trade-mark registered abroad, he could, no doubt, secure full satisfaction for the infringement, and in all probability the foreign manufacturer would not have attempted to use the trade-mark in this fraudulent manner." The interest in this case is not by any means limited to America, and British firms anxious to secure such protection as the Courts in China are able to afford will profit from the incident and its lesson.

Some Present-day Development.

The manager of a leading American steel company returned to the States last month from a 13 months' trip round the world. The *Wall Street Journal* published a most interesting interview with him, and in the article more space was devoted to China and its wonderful possibilities than to all other parts that he had visited. The Hanyang Iron and Steel Works at Hankow have been manufacturing steel since 1894, and they have a well-equipped works—parts are now undergoing remodelling—producing high-quality steel, and employing 20,000 people. Common able-bodied labourers receive about 7 cents per day, and women about 5 cents per day; boiler-makers earn $7·50 to $10 per month. As was pointed out in the interview, "such prices as these for skilled labour, and a maximum of about 45 cents a week for common labourers at the mines, place the production of steel out of competition with a like product in the States, and it is only a question of time when China will be a large producer of iron and steel." This cheap-labour question is likely to be a deciding factor in handling foreign competition in other departments of industry too—the "Heathen Chinee" has a long way to go in Western Civilization before he will arrive at our Trade Union rates of wages! The Yangtse engineering works now about completing at Hankow commence with 1,000 men and they will build engines, boilers, ships and general machinery. But these new works that have sprung up are only a small beginning. Electrical installations will be needed for the equipment on modern lines of the innumerable works and undertakings that will be started in the next decade or two, and British electrical prestige in that market must not be allowed to suffer. Americans claim that they are so much nearer to the Orient that their goods can arrive there within three weeks, and they urge manufacturers and merchants in the States to take advantage of a splendid opportunity to get into the field early, as "it will be much more difficult to get trade after others have thoroughly established themselves, and the British, French and Germans are not slow to take advantage of such conditions." All such information as this is worthy of study by the Britisher—not to influence him to keep "hands off," because he may imagine that others are so favourably placed that he does not stand a chance, but to guide him as to the importance of a policy of immediate aggression.

It may be thought that we have gone rather more fully into the trade prospects in China than the immediate electrical requirements, as at present understood, justify. It is our belief, however, after what we have heard from the lips of visitors to the Electrical Review offices, and from what we have read on the matter, that those interested in British electrical trade abroad should look closely into the case of China, and we hope that some of them, at any rate, will in some way or other profit from what we have written.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

GERMANY (*concluded*).

	Marks per 100 kg.
Insulating coils, bells, and buttons, bobbins, keys, switches, and similar parts of electrical fittings, of earthenware, porcelain, or glass, not combined with other materials, and not admitted as "parts of electro-technical appliances imported in sections":	
White	10
Coloured	20
Insulating appliances (bobbins, safety boxes, tubes, disks, rings, and the like) of asbestos, asbestos paste, mica or micanite, for electro-technical purposes ...	15
Arc lamps	40
Complete cases for arc lamps in combination with glass globes covered with network or not; reflectors, search-lights	20
Electric incandescent lamps	80
Vehicles intended to run on rails:	
In combination with motive machinery, except steam locomotives	10
Without motive machinery:	
Passenger carriages without leather work or upholstery	7·50
Passenger carriages with leather work or upholstery; tramcars for passengers; cars of all kinds for mono-rails	12

In addition to the ordinary tariff rates quoted above, a new law of July 15th, 1909, imposes, as from October 1st, 1909, an internal tax on certain lamps and materials for lighting purposes (so far as they are destined for use in Germany) at the rates shown in the subjoined statement. These duties are applicable both to German made and to imported goods, and, as regards the latter, are leviable in addition to the import duty:—

	Rate of internal tax.
A. Electric incandescent lamps and burners therefor:	Pfennig.
(*a*) Carbon-filament lamps—	Each.
Up to 15 watts	5
Over 15 up to 25 watts	10
„ 25 „ 60 „	20
„ 60 „ 100 „	30
„ 100 „ 200 „	50
And for each 100 watts in excess of 200	25
(*b*) Metal-filament lamps, Nernst lamp burners and other incandescent lamps—	
Up to 15 watts	10
Over 15 up to 25 watts	20
„ 25 „ 60 „	40
„ 60 „ 100 „	60
„ 100 „ 200 „	100
And for each 100 watts in excess of 200	40
B. Mantles for incandescent gas and similar lamps ...	10
C. Carbons (*Brennstifte*) for electric arc lamps—	Per kg.
(1) Of pure carbon	60
(2) Of carbon combined with other materials (*mit Leuchtzusätzen*) and all other carbons	100
D. Burners for mercury-vapour and similar lamps—	Each.
Up to 100 watts	100
Over 100 watts, for each 100 watts in excess	100

The tax is to be paid by the producer of the articles by affixing tax stamps to the packages before the completely packed articles are removed from the factory, &c., where they are made. In the case of imported articles, the tax is to be paid by the importer at the time of clearance through the Customs house.

Articles and materials for lighting which are liable to taxation under the present law may not be removed from the place of manufacture in Germany or imported into Germany from foreign countries, otherwise than in completely closed packages which cannot be opened without leaving recognisable traces. The kind of packing and the permissible size of each package is to be prescribed by the Bundesrat. Particulars of the contents are to be marked on each package—*i.e.*, in the case of electric incandescent lamps, burners therefor, and mercury-vapour and similar lamps, the number and watt-consumption; in the case of mantles, the number; and in the case of carbons for arc lamps, the net weight. In addition, each package must bear an indication of the tariff class under which it is liable to duty, and the designation of the contents (trade mark).

NEW PATENTS APPLIED FOR, 1909.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

19,826. "Improvements in electric switches." EINAR LUNDSTEEN UND AKTIESELSKABET INTERNATIONAL ELEKTRISK TRAPPEAUTOMAT. August 30th. (Complete.)

19,834. "Improvements in or connected with telegraph or telephone insulators and the like." H. LAVY. August 30th.

19,914. "Improvements in or connected with electric batteries." G. FULLER. August 31st. (Complete.)

19,974. "Improvements in controllers for electric motors." G. E. EDWARDS and H. ROGERS. September 1st.

20,003. "Improvements in adjustable transformers for polyphase electric alternating currents." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens Schuckertwerke G.m.b.H., Germany.) September 1st. (Complete.)

20,004. "Improvements in the driving arrangements of looms." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens Schuckertwerke, G.m.b.H., Germany.) September 1st. (Complete.)

20,005 "Improvements in the regulation of alternating current commutator dynamo-electric machines." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens Schuckertwerke G.m.b.H., Germany.) September 1st. (Complete.)

20,008. "Improvements in conduits for electric light, telephone and telegraph cables or conductors and the like." A. WATKINS. September 1st.

20,010. "Improvements in the manufacture of filaments for incandescence electric lamps." G. T. B. COBBETT, R. DE FAZI and F. GRILL-CLAUSSEN. September 1st.

20,035. "Improvements in and relating to electrical connectors." B. F. SOBOTKA. September 1st.

20,055. "Improvements in or relating to regulators for storage batteries." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) September 1st. (Complete.)

20,057. "Improvements in apparatus for electro-plating." S. O. COWPER-COLES. September 1st.

20,105. "Improvements in filling electric joint boxes." C. J. BEAVER and E. A. CLAREMONT. September 2nd.

20,106. "Improvements in electric joints." C. J. BEAVER and E. A. CLAREMONT. September 2nd.

20,115. "Improvements in and connected with current collectors for electric traction systems." S. P. (SUCHOSTAWER PATENTS) SYNDICATE, LTD., and H. M. SAYERS. September 2nd. (Complete.)

20,129. "Improvements in and means for the production of long continuous electric arcs." J. Y. JOHNSON. (Badische Anilin and Soda Fabric, Germany.) September 2nd.

20,175. "Improvements in and connected with the control of series-wound dynamo-electric machines." J. G. P. THOMAS. September 3rd.

20,192. "Improvements in processes and apparatus for the electrolytic production of salt solutions." T. GIRTIN. September 3rd. (Complete.)

20,211. "Improvements relating to telephone transmitters." E. A. GRAHAM. September 3rd. (Complete.)

20,218. "Improvements in electro-magnetic switch mechanism." OTIS ELEVATOR CO., LTD. (Otis Elevator Co., United States.) September 3rd.

20,229. "Improvements in transmitting apparatus for wireless telegraphy." G. MARCONI and MARCONI'S WIRELESS TELEGRAPH CO., LTD. September 3rd.

20,230. "Improvements in wireless telegraph transmitters and receivers." G. MARCONI and MARCONI'S WIRELESS TELEGRAPH CO., LTD. September 3rd.

20,241. "Improvements in electrical ignition mechanism for internal combustion engines." A. GIRAUD. (Date applied for under Sec. 91 of the Act, September 3rd, 1908, being date of application in France.) September 3rd. (Complete.)

20,246. "Improvements in and relating to the control of electric motors." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) September 3rd. (Complete.)

20,272. "Azimuth and steering rings for reduced diameter card, magnetic or ships' compasses." H. BROWN. September 4th.

20,286. "Elastic electromagnet power-transmitting device, particularly for use with automobiles, locomotives and the like." W. DMITRIEW. September 4th. (Complete.)

20,311. "Improvements in arc lamps." A. G. BLOXMAN. (Gebruder Siemens and Co., Germany.) September 4th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

ELECTROLYTIC METERS. W. B. Thorpe. 865. January 14th. (Post-dated July 14th, 1908.)

ELECTROLYTIC GALVANIC PROCESS. C. Bianco. 15,031. July 15th.

ELECTRIC CONDUCTORS. R. K. Gray. 17,283. August 17th.

ELECTRICAL SWITCHES. H. W. Cox. 17,315. August 18th.

COMPOSITION APPLICABLE FOR USE IN ELECTRICAL RESISTANCES, FIREPROOF BODIES, AND CONSTRUCTIONAL WORK. W. A. Phillips and F. R. Bacon. 17,340. August 18th.

APPARATUS FOR WIRELESS TELEGRAPHY. G. Marconi and Marconi's Wireless Telegraph Co. 17,505. August 20th.

ELECTRIC HEATING APPARATUS. R. G. Pheysey. 17,687. August 22nd.

ELECTROLIERS. R. S. Woods. 19,188. September 12th.

ELECTRODEPOSITION OF METALS. J. J. N. Brachmann. 23,198. October 30th.

WINDING AND DISPOSING OF THE SECONDARY CIRCUITS OF INDUCTION COILS USED WITH TELEPHONE APPARATUS. R. R. Harper. 23,739. November 6th.

ELECTRODES FOR USE IN ELECTROLYSIS. C. C. Connor, J. W. Stubbs and Electrolytic Alkali Co. 23,930. November 9th.

PROCESS OF ELECTROPLATING ARTICLES OF ELECTRICALLY NON-CONDUCTIVE MATERIAL. A. Gerbing. 24,139. November 16th.

ELECTRIC BATTERIES. H. de Martis. 26,285. December 4th. (Post-dated August 17th, 1908.)

TELEPHONE INSTRUMENTS. D. B. Clarke. 26,315. December 5th.

ELECTRIC IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. A. W. Bird and Thomson Bennett, Ltd. 26,894. December 11th.

MAGNETO-ELECTRIC IGNITION DEVICES FOR INTERNAL-COMBUSTION AND LIKE ENGINES. R. Wattles. 28,343. December 29th.

PROCESS FOR MANUFACTURING FLAT INCANDESCENT FILAMENTS FOR METALLIC-FILAMENT ELECTRIC LAMPS. W. Schaffer. 28,554. December 31st. (Date applied for under International Convention, January 2nd, 1908.)

1909.

INDUCTION COILS FOR IGNITION AND OTHER PURPOSES. E. C. R. Marks. (Chicago Coil Co., United States.) 318. January 6th.

LAMPHOLDERS FOR ELECTRIC INCANDESCENT LAMPS. T. Birchall. 1,673. January 23rd.

WIRELESS ELECTRIC SIGNALLING DEVICES FOR INDICATING THE RELATIVE POSITIONS OF SHIPS. R. Degener-Böning. 2,845. February 4th.

STORAGE BATTERIES. C. H. Montgomery, J. B. Young, R. E. Hellyer and R. J. E. Baker. 9,692. April 26rd.

SIGNALLING APPARATUS OPERATED FROM A DISTANCE. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 14,240. June 15th.

BEARINGS OF ELECTRICITY METERS. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke Ges.) 16,533. July 15th.

Electro-Chemical Industry in Switzerland.—The Electro-chemical industry of Switzerland is making marvellous progress; there are at the present time 22 works established and others under construction, whilst the power utilised is calculated to be 100,000 H.P. During the last year electro-chemical products were exported to the value of £310,000, and the whole of the requirements for home consumption were also manufactured. Nearly £80,000 worth of aluminium was exported, and the other principal items were the nitrates and artificial manures produced in the electrical furnaces which have been built.

The Efficiency of Illuminating Agents.—From a report presented to the German Imperial Cabinet in reference to a proposed tax on electrical energy and gas, the following figures are taken, showing the illuminating value of the different types of electric lamps and gas burners.

In electric lamps one KW.-hour produces—

	Candle-hours.
Ordinary incandescent	330
High-efficiency incandescent	500
Nernst	500
Osram, tungsten, &c.	700 to 1,000
Arc lamps, alternating	800
" " continuous	1,000
" " flame	2,000
Mercury vapour...	1,600
" and quartz tube	3,000

For gas lighting one cubic metre gives—

	Candle-hours.
Incandescent upright	560
" inverted	1,000
High-pressure gas	1,000

Electrical Haulage at the Friedrichshall Potash Mines.—Some detailed information as to the working of these mines is published in *E. K. & B.* for July 24th. The haulage plant is large enough to develop 250 H.P. on the rope, and can lift 75 tons per hour from a depth of 900 metres. At present the working depth is only 500 metres, and the quantity dealt with is far less than the maximum, but, as the following figures show, even under these circumstances some very creditable results have been attained:—

Length of test in hours	12	16	8
Average No. of lifts per hour	9·5	7	18
Total weight raised in tons	219·8	211·4	351·36
Depth (metres)	500	500	500
Average H.P. on the rope	34	24·5	81·5
Average H.P. as a percentage of full load (250 H.P.)	13·6	9·8	32·6
Total KW.-hours used	590	546	818
KW.-hours for H.P.-hours on rope ...	1·45	1·4	1·26
Steam consumption per KW.-hour (lb.)	20·5	20·7	20·0
Steam consumption per H.P.-hour on the rope (lb.)	29·7	29	25

It will be seen that even with a load of only about 10 per cent. of the maximum the consumption is as low as 29 lb. of steam per effective H.P.-hour, and this is but little more than the consumption at one-third load. This point is of special importance in connection with potash mines because of the great variations in output. Even when the actual consumption over a long period is considered, including the non-productive traffic for inspection, &c., the results are only slightly worse, as is shown by the following figures extending over a period of a quarter of a year:—

Total tons raised	24,149
Total working hours	1,431
Average H.P. on the rope	31·2
Average H.P. as a percentage of full load (250 H.P.) ...	12·3
Total KW.-hours used	67,898
Steam consumption per rope H.P.-hour at 20·7 lb. per KW.-hour (lb.)	31·5